The Perception of Community on Coastal Erosion Issue in Selangor, Malaysia

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Abstract──**Malaysia is a maritime nation blessed with invaluable coastlines. Hence it is important to preserve its precious coastal areas in a sustainable manner. However, coastal areas are continuously facing tremendous development pressures both from natural and anthropogenic factors. These include tsunami event, rapid urbanization process, aquaculture sector, oil and others. Consequently these situations create problems to coastal areas. For instance, the issues of erosion and loss of habitats are significant in many maritime nations. Thus, this research was initiated by the global phenomenon on coastal areas, particularly erosion problem. The research addresses the issue of coastal erosion as one of the key coastal problems in Selangor. The coastlines of Selangor were selected as it experienced erosion problem relatively significant due to continuous development growth. The objectives of the research were: to comprehend the perception of the coastal community in relation to the issue of coastal erosion in Selangor; to analyze the causal factors contributing to coastal erosion in Selangor; and to analyze the severity of coastal erosion issues in Selangor. Research methods applied was mainly by conducting questionnaire survey to a total of 377 coastal residents and site-observation. This analysis demonstrates that Selangor is currently experiencing severe erosion problems at some stretches of its coastlines, which were considered as Rank 1 (extremely dangerous). These areas involved 33 km of coastal areas. Among the areas are Bagan Beting, Sungai Besar, Bagan Sekinchan, Jeram and Sungai Sembilang. Results from questionnaire survey also indicated that coastal erosion was significant in Selangor with 77% of respondents agreed to that statement. In addition, 75% of them felt that their coastlines were considered as 'seriously affected'. Overall, this research managed to achieve its outlined objectives.**

Index Terms──**Coastal erosion, Selangor, coastal residents, coastal management.**

I. INTRODUCTION

Coastal zone has a high value of socio-economic activity. Several aspects of, coastal area are included in the coastal environment profile including physical setting and land use, natural resources and environment, fisheries and aquaculture, tourism, shipping and other economic factors. It supports a large percentage of population and it is also the center of economic activities encompassing urbanization, agriculture, oil and gas exploitation, transportation and communication. Nowadays, there has been increase in activities involvingland utilization and development in the coastal zone from various sectors resulting in some of them causing damage and destruction in the coastal zone. In most cases, erosion occurs

due to natural causes but there are cases of erosion due to interference in nature by man.

Reference [1] distinguishes between erosion and scouring, which he says it relates with the mechanisms by which shore retreat occurs on Johor's western coast. This distinction is based on the results of many case studies carried out in Malaysia over a long period of time. He believes that when a cohesive material is immersed under tidal water, its properties are changed and it becomes erodible. The scouring is caused by wave impact and proceeds shoreward by keeping a constant critical land elevation. The situation is accentuated by the abrasive action of driftwood, which further contributes to the disappearance of coastal lands.

Regardless of the underlying mechanism of mud coast erosion, man's action in the coastal zone serves to either initiate or accelerate further erosion. Bund revetment only protects the properties behind it against erosion. Along the protected area at both ends; erosion continues and, most likely, becomes more severe because of the effects of wave diffraction. This phenomenon can be clearly seen at the Buntu and Rimba Terjun areas, where the erosion down-coast of the completed revetment became more severe after the completion of the revetment.

This research is focused towards analyzing the issue of coastal erosion hazard and the case study area that has been chosen is along the Selangor shoreline.

II. PROBLEM STATEMENTS

A. Uncontrolled Human Intervention and Coastal Development

Throughout the history of mankind in coastal areas, boundary between the land and the sea has played an important role in society and has primarily been the sites for human settlements and highly productive agriculture. Moreover, deltas and estuaries have always been ecologically important and have become economically important as well. The significant of these areas is still more evident when the broader coastal zone is considered.

Development within coastal areas has increased interest in erosion problems; it has led to major efforts to manage coastal erosion problems and to restore coastal capacity to accommodate short and long-term changes induced by human activities, extreme events and sea level rise. The erosion problem becomes worse whenever the countermeasures (i.e. hard or soft structural options) applied by inappropriate, improperly designed, built, or maintained and if the effects on adjacent shores are not carefully evaluated. Often erosion is addressed locally at specific places or at regional or jurisdictional boundaries instead of at system boundaries that reflect natural processes. This

anomaly is mostly attributable to insufficient knowledge of coastal processes and the protective function of coastal systems [2].

The coastal areas house for about two-third of the world population. Many large cities have developed within coastal zones for example Shanghai, Bangkok, Tokyo, London, and New Orleans [3]. However, coastal zone have also contributed to environmental and social problems. Pollution resulting from solid and liquid wastes causes by intensive human activities is well documented.

In the Malaysian context, the National Coastal Erosion Study conducted by the Department of Irrigation and Drainage in 1986 has found that 1,300km out of 4,300km of Malaysian coastline was eroded. One of the example is TanjungPiai in Johor Bharu, the southernmost point of Peninsular Malaysia and mainland Asia, continues to be threatened from severe coastal erosion. The erosion is caused by the large waves created by an increasing number of ships utilizing the Straits of Malacca and the Port of Tanjung Pelepas, and is most prevalent in areas of the Sungai Pulai estuary.

Coastal zones are particularly vulnerable to the impacts of nature and man and are physically very unstable. Erosion and associated loss of land is the most evident sign of this instability. Negative shoreline trends cause secondary effects that affect society through threats to human settlements, harbors, coastal recreation areas, wetlands and marshes. These impacts are expected to increase as a consequence of climate change leading to a sea level rise.

In Indonesia, coastal erosion started in the northern coast of Java Island in the 1970s when most of the mangrove forest had been converted to shrimp ponds and other aquaculture activities, and the area was also subjected to unmanaged coastal development, diversion of upland freshwater and river damming. Coastal erosion is prevalent throughout many provinces, [4]such as Lampung, Northeast Sumatra, Kalimantan, West Sumatra (Padang), Nusa Tenggara, Papua, South Sulawesi [5] and Bali [6]. US$79.667 million was provided by the Indonesian Government to combat coastal erosion from 1996 to 2004, but only for Bali Island in order to protect this valuable coastal tourism base. A combination of hard structures and engineering approaches (breakwaters/jetties/revetments) of different shapes that fused functional design and aesthetic values, and soft structures and engineering approaches (beach nourishment) was used. They succeeded in stopping coastal erosion on Sanur, Nusa Dua and Tanjong Benoa beaches, but were neither cost effective nor efficient, because during low tide all of the coastal area was exposed up to 300 meters offshore; thus, these huge structures were revealed and became eyesores.

B. Excessive Sand Mining

The mining of sand and gravel along beaches and in the surf-zone will cause erosion by depleting the shore of its sediment resources. In connection with maintenance dredging of tidal inlets, harbors, and navigation channels, sand is very often lost from the littoral budget because the sand, unless otherwise regulated by legislation, is normally dumped at deep water. Coral mining and other means of spoiling the protective coral reefs, for example, fishing by the use of explosives or pollution, will also cause coastal erosion and beach degradation. The protective function of the reef disappears and the production of carbonates sand stops.

Sand mining is a type of open-cast mining that provides material for the construction sector in Ghana. The construction sector in the coastal areas of Ghana relies heavily on coastal sand and pebbles in the building of houses, bridges and roads. Its contribution to Ghana's industrial output has increased from 17.4 per cent in 1986 to 20.8 per cent in 1993. However, the process of sand mining has accelerated coastal environmental degradation to an alarming rate in many areas. As a result, the government has been compelled to spend millions of dollars to combat sea erosion [7].

There was an issue of illegal sand mining or excessive and uncontrolled sand mining that could lead to the contamination of the river and lead to a water crisis in the Klang Valley reported in the local newspaper in 2010. The article also mentioned that, the Selangor state government was determined to prevent sand thefts, it must set up a new enforcement team managed by the Land and Mines Office.

III. GOAL AND OBJECTIVES

The goal for this research is to analyze the issue of coastal erosion hazard along the Selangor coastlines. In order to achieve the above goal, there are four objectives that have been identified:

1) To comprehend the perception of the coastal community in relation to the issue of coastal erosion in Selangor;
2) To analyze the causal factors contributing to coastal erosion in Selangor; and
3) To analyze the severity of coastal erosion issues in Selangor.

IV. METHODS AND MATERIALS

This research implemented observation and mapping as the main tools. For observation, the five coastal districts had been chosen which are Sepang, Kuala Langat, Klang, Kuala Selangor and Sabak Bernam. Observation was made on the ground to see the current condition of the coastal area, the land uses of the adjacent area, coastal erosion occurrence, and the existence of any coastal defense in the area.

Moreover, in order to strengthen the analysis for this research, coastal erosion risk assessment was implemented. There are a variety of natural and human-induced factors that influence the erosion process. For example, shoreline orientation and exposure to prevailing winds, open ocean swells and storm surges, and waves all influence erosion rates. Beach composition influences erosion rates as well. The factors are as follows:

- Shoreline type
- Geomorphology of the coast
- Structure types along the shoreline
- Density of development
- Proximity to erosion inducing coastal structures
- Nature of the coastal topography
- Shoreline exposure to wind and waves

The causes of erosion are often difficult to determine and usually require a skilled interpretation of the processes and activities affecting a particular area.

All these factors were applied for Selangor coastline and secondary data such as the Selangor State Structure Plan and the technical report of Selangor State Structure Plan were cross-referenced. The results were based on the current condition in Selangor coastline.

Questionnaires survey is the supporting tool of data collection employed in this study. The questionnaires surveys contained both open-ended and closed-ended questions. For the questionnaires surveys sampling selection, only a number of samples were taken representing for the whole group of respondents. Sampling method that was implemented in this study was stratified sampling. The target groups were divided into two, i.e. the officers working in public agencies and the local community living in the five coastal districts that were mentioned before. As for the public agencies, there were three public agencies selected namely, Selangor Town and Country Planning Department, Lembaga Urus Air Selangor (LUAS) and Department of Drainage and Irrigation (DID). The people in the public agencies who involved for the questionnaire surveys were given three working days to complete the survey form before the researchers recollected the survey forms. There were 50 questionnaires survey forms distributed to all these agencies and only 36 of respondents participated. For the second target group, the community selected was residents living within 3 kilometers landward from the coastal lines. For a survey design based on a simple random sample, the sample size required can be calculated according to the following formula.

Formula:

$$n = t^2 \times p(1\text{-}p) / m^2$$

Description:
n = required sample size
t = confidence level at 95% (standard value of 1.96)
p = estimated population living in coastal area
m = margin of error at 5% (standard value of 0.05)

Based on the above calculation formula, the same formula has being applied for this research. For this research, cluster sampling method was applied. In this research, five-cluster group has been identified, i.e. the five coastal districts (Table I). Of the five coastal districts, Klang has the biggest sampling size, i.e. 196 people. The estimations were made based on the key economic activities on the coastal area for each district and also the existing land uses in the area. The pattern of sampling size reflects the economic growth rate of the district.

TABLE I: POPULATION SAMPLES FOR THE STUDY AREA

District	Estimation % of Coastal Population	No. of Sampling	Total Population (2010)
1. Sabak Bernam	3%	4 people	46,354
2. Kuala Selangor	3%	4 people	205,257
3. Klang	15%	196 people	744,062
4. Kuala Langat	5%	73 people	220,214
5. Sepang	7%	100 people	204,354
TOTAL		**377 people**	**1,423,271**

V. RESULTS AND DISCUSSION

Based on the observation that has been done by the researchers, most of the areas were suffering from a severe coastal erosion issue especially Kuala Selangor district, classified as Rank 1 (extremely dangerous). These areas involved 33 km of coastal areas. Among the areas are Bagan Beting, Sungai Besar, Bagan Sekinchan, Jeram and Sungai Sembilang.

For Kuala Selangor district, PantaiRemis has been chosen to represent the district for the erosion issue. Form the observation that has been done on the 17 July 2012, PantaiRemis suffered severe erosion. The erosion level can be categorized as ranking 1. Fig. 1 shows the current condition of the coastal areas where it can be seen that some of the facilities such as the road along the beach area was damaged because of the erosion issue. There was some breakwater structure along the beach but they were damaged.

Fig. 1: Existing condition of coastal erosion in Pantai Remis, Kuala Selangor.

Some of the new facilities were also damaged because of this issue. A drainage that has just been built was damaged because of the movement of the sand in the coastal area. The set-up of this engineering approach is to act as a coastal defense, handling the coastal erosion occurrence though it is meant for temporary only. The long term planning will rely on a more ecological approach which is proven more effective taking into consideration the nature of coastal environment that is so fragile to any changes.

In Klang District, the area that has been chosen is Port Klang. The activities that were conducted mostly related to logistic activities. There were several big ships in the area and also a few restaurants that can be found near to the coastal area. There was no severe erosion occurred in the area, only some minor erosion. During the observation, there was some outdoor stage that has been built there. It shows that there was some light tourist activities happening in the area and it is believe that the activity does not give impact to the coastal area.

Table II shows the data regarding the coastal erosion issue along the Selangor coastline. This data was obtained from the DID Selangor. From the table, it shows that coastal erosion is divided into three categories. Based on the National Coastal Erosion Study commissioned by the Economic Planning Unit in 1985, category one can be regarded as critical erosion areas where shore-based facilities and economic activities are in immediate and imminent danger. Moreover, the National Coastal Erosion Study 1985 indicate that erosion in category 2 as significant erosion areas where shore-based facilities and economic activities are expected to be endangered within 5 to

10 years if no remedial action is taken and lastly category 3 as acceptable erosion areas that are generally undeveloped with consequent minor economic loss if coastal erosion continues unabated.

TABLE II: COASTAL EROSION IN SELANGOR, 2011

Category	Coastline (km)
One	63.5
Two	22.3
Three	66.1
Total	151.9

Source: DID, Selangor

A. Community's Perception on Coastal Erosion Issue in Selangor

Based on the questionnaire survey conducted to 377 respondents, 292 respondents (77.5%) responded to 'yes' to the question on the existence of issues of coastal erosion occurring along the Selangor coastline and only 85 respondents (22.5%) of respondents gave the opposite view (Fig. 2).
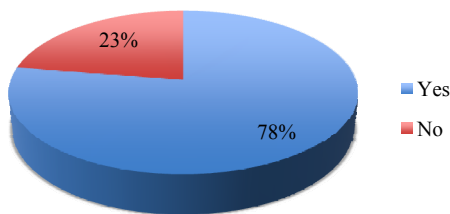

Fig. 2. Respondents' perception on the existence of coastal erosion in Selangor

In terms of severity, this question was dedicated to them based on their observation on living near the affected area. The result shows that, 75% said that the coastline in Selangor was seriously affected, followed by moderately affected with 19%. Only 5% and 0.8% responded with minor affected and not affected. This shows that the community living by the sea could aware of the coastal area was suffering from erosion. Fig.3 indicates the severity level of coastal erosion in Selangor based on the questionnaire survey conducted.
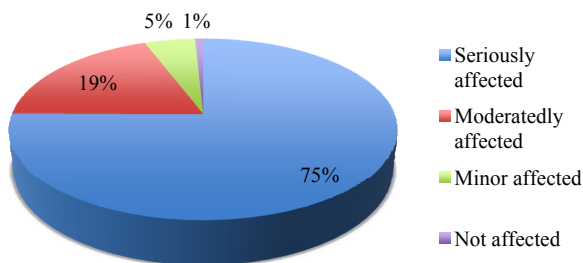

Fig. 3. Severity level of coastal erosion in Selangor

B. Factors contributing to coastal erosion in Selangor

There are several factors that have been identified as factors that contributed to coastal erosion in Selangor (Table 3). The result shows that human activities and modification of the coast recorded a total score of 1734 with the average sum of 4.6. The table shows that 65% of respondents were strongly agreed with this factor follows by 35% of the respondents respond with agreed. None of respondents decided to choose undecided, disagree or strongly disagree. Scholar [8] agree that humans contribute to the erosion process by removing vegetation which then allows wind and precipitation to directly erode the soil, directing runoff from streets, parking lots, roofs, and other locations (e.g., over a bluff and causing erosion). Humans also alter the coastline by constructing "hardened" structures on the shore, which blocks littoral processes and can reflect wave energy onto adjacent shoreline areas or cause deepening of the nears shore area.

Excessive beach and sand mining recorded in second with the score of 1,616 and the average sum of 4.3. 61% of respondents strongly agree with this factor as the factor that contributes to coastal erosion in Selangor. 28% of respondents with agree, 7.6% undecided, 2.4% disagree and 0.2% strongly disagrees. Each country has the limit on sand mining. Same goes to Malaysia. Sand mining can be conducted on coastal area in Malaysia as well as Selangor but there are certain extents where sand mining can be allowed. Reference [9] also report that there was an issue of illegal sand mining or excessive and uncontrolled sand mining that could lead to the contamination of the river and lead to a water crisis in the Klang Valley.

Change in wave climate recorded a total score of 1604 and the average sum of 4.25. There is not much different between the second factor and the third factor in terms of average sum. Strongly agree recorded with 63%, agree recorded with 24%. Followed by undecided with 9.5% and disagree with 3.5%. This third factor can be classified as natural factor that can contribute to erosion.

The fourth factor that can contribute to coastal erosion is sea level rise. This factor also considered as natural factor, which is the same as the third factor. This factor recorded a score of 1376 and with the average sum of 3.62. Strongly agree recorded with 38%, agree recorded with 32%, undecided with 21%, disagree with 7% and strongly disagree with 2%.

The last factor is degradation of fringing coral reef with the total score of 1362. The average sum recorded for this factor is 3.61, which is 0.01 differences from the fourth factor, which is sea level rise.

TABLE III: FACTORS CONTRIBUTE TO COASTAL EROSION IN SELANGOR

Factors	Total	Average sum
Human activities/ Modification of the coast	1,734	4.6
Excessive beach/ sand mining	1,616	4.3
Change in wave climate	1,604	4.25
Sea level rise	1,376	3.62
Degradation of fringing coral reef	1,362	3.61

VI. CONCLUSION

In essence, this research has discussed the coastal erosion occurrence along the coastlines of Selangor state in Malaysia. The data obtained by conducting primary research on the ground demonstrates that the local community perceives

erosion problem is relatively considered as severe and could damage further. The majority of respondents stated that the coastal areas are seriously affected by the erosion problem. In this regards, the respondents felt that the key factor for this alarming state is related to human induced activities. The analysis of the results and its findings indicate that the coastlines of Selangor were exposed to various degree of erosion, consisting of rank 1, 2 and 3. These results should be treated seriously as it could damage the invaluable natural resources of the nation. Thus, it is hoped that this research has paved the way for comprehensive approach for planning and managing coastal areas taking into account the mitigation measures in combating the issue of coastal erosion in Malaysia.

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