Report of Erasmus+ Project: Marine Coastal and Delta Sustainability for Southeast Asia (MARE)
Universiti Teknologi PETRONAS, Malaysia (UTP)

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Topic: *A Study of Vulnerability of Manjung Coastline using QGIS*

Introduction

The scope and the objective of the project is develop the mapping of physical and socio-economic parameters using QGIS with the aim of creating the Coastal Vulnerability Index (CVI) for measuring the vulnerability of the Manjung coast. Therefore, the output of the project is create the coastal vulnerability map to reflect the physical and socioeconomic aspects of the Manjug's coast.

Information about the analysis' object: Manjug's coast and vulnerability.

Manjung has a total of 115 km of coastline facing the Straits of Malacca: 85 km long coast of West Peninsular and 30km of Pangkor Island coast.
Due to climate change, particularly with the rise in sea level, substantial impacts on the vulnerability of coastal areas are being observed, which could pose risks to the development of these areas. Understanding coastal vulnerability is crucial for the sustainable development of coastal regions; in fact, the Coastal Vulnerability Index (CVI) has been developed to identify and manage vulnerable locations along the coast. The absence of interventions can lead to a greater impact on the shape of the coastline, resulting in erosion, degradation of coastal resources, loss of development opportunities, decrease in land value, as well as increased exposure of human life and assets to coastal hazards due to climate change.
To assess the vulnerability of the coast of Manjung in Malaysia, three parameters have been considered: the physical parameter, the socio-economic parameter, and the biodiversity parameter. Each of these parameters, in turn, is characterized by a set of variables:

- For the physical parameter, the variables are: *geology, geomorphology. tidal range, erosion, floods, sea level rise, tsunami risk, sea marsh protection.*
- For the socio-economic parameter, the variables are: *population, community institutions and facilities, infrastructure and utility systems, communication and transportation systems, business and industry, agriculture and animal husbandry.*
- For the biodiversity parameter, the variables are: *existence of marine biodiversity areas, marine biodiversity gazetted status, marine biodiversity conservation program, status of threatened areas of marine biodiversity.*

Each of these variables has been classified according to five levels of vulnerability: very low, low, medium, high, extreme.

Categories	1 – Very Low	2 – Low	3 – Medium	4 – High	5 – Extreme
Color Scheme					

Then, combining the levels of variables belonging to the same parameter, is calculated the Coastal Vulnerability Index (CVI) for each section of the study area.
Is therefore obtained:

- *The Physical Coastal Vulnerability Index (CVIP)* that is a crucial tool for assessing coastal risk, particularly in relation to the ability of coastal areas to withstand and adapt to potential disasters. In Malaysia, coastal erosion and flooding are common risks that can be triggered by natural events like astronomical tides, storm surges, rising sea levels, and tsunamis. Human activities, such as construction, reclamation, and sand mining, also contribute to the vulnerability of coastal regions.
- *The Socio-Economic Coastal Vulnerability Index (CVIS*) which focuses on balancing development activities and addressing socio-economic conflicts while considering the impact of coastal disasters on municipal and economic aspects.
- *The Biodiversity Coastal Vulnerability Index (CVIB*), analysis aims to comprehensively understand the presence, conservation status, and potential threats faced by marine biodiversity. It plays a crucial role in identifying and preserving areas of biodiversity interest, ensuring the protection and restoration of biodiversity-rich regions.

The combination of these three components results in the *National Coastal Vulnerability Index (NCVI)*, which provides a holistic measure of coastal vulnerability. The NCVI guides decision-making, facilitates effective planning, and promotes sustainable coastal development. By aligning development plans with identified risks and considering sector-specific attributes, the CVI analysis aids in implementing early adaptation and intervention measures.
Finally, coastal vulnerability map generated to highlight vulnerability indices of Manjung coast of Malaysia.

My contribute to the project

During my stay in Malaysia, I supported the PhD students Vasukey Palany Kumar and Shaerra Amiera in using QGIS.
Specifically, using the QGIS software, we created two maps that highlight the vulnerability along the coast of Manjung.

The first map was created using the physical parameter, and among its variables, the Geomorphology variable was selected: *geomorphological variables determine the fragility of the coastline against erosion. Parameters taken including rocky, indented beaches, gravelly, sandy, muddy, etc.*
As mentioned earlier, this variable was classified into five levels of vulnerability, which correspond to:

	Physical Parameter	Ranking of Physical Vulnerability				
		Very Low (1)	Low (2)	Moderate (3)	High (4)	Very High (5)
##	Geomorphology (2) on the top	Rocky Cliff	Composite of sand and Rocks	Sand-SABBIA	Composite of clay and sand	Muddy flat area

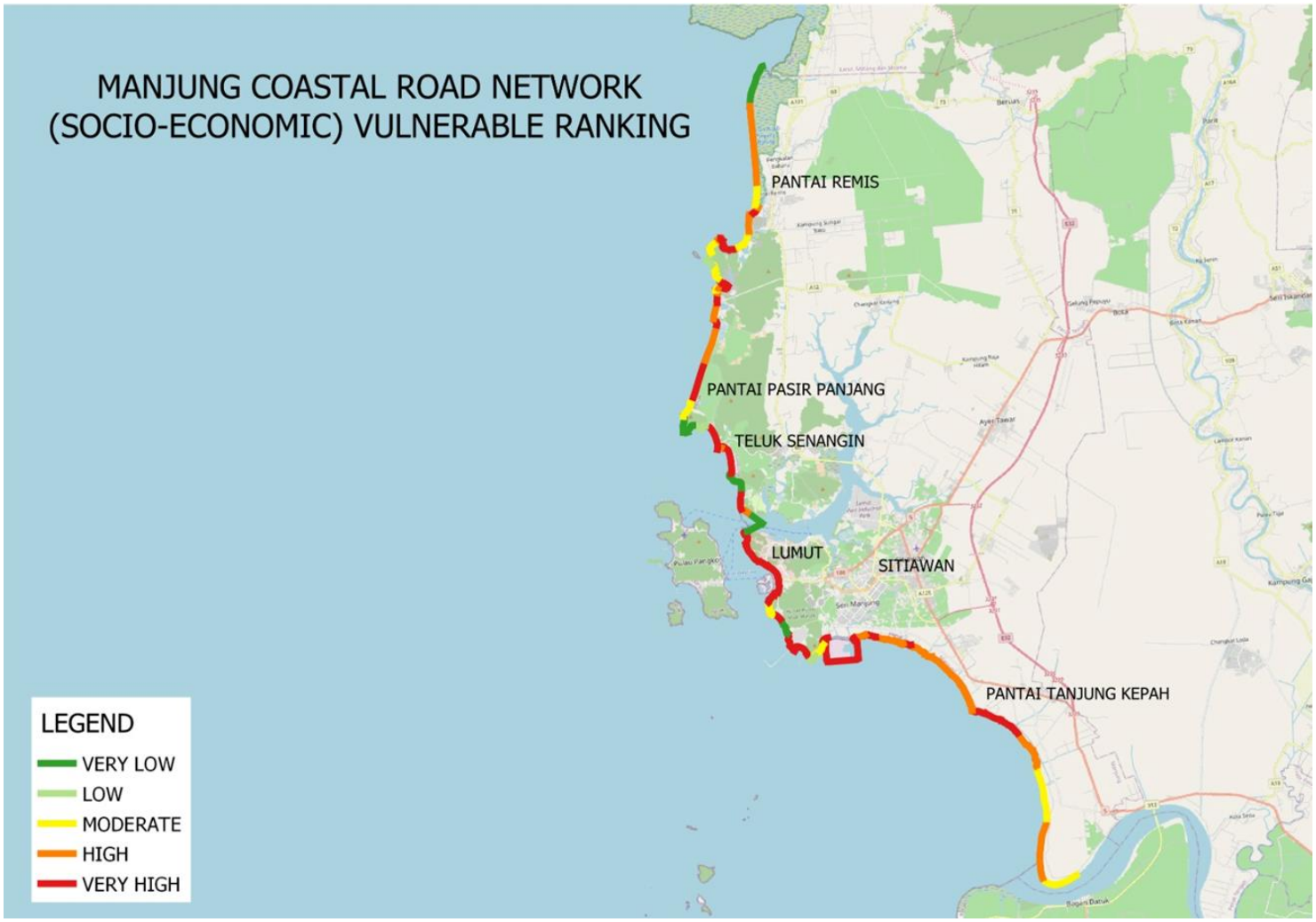
To create the map, the "shoreline" shapefile and the "Geological Mapping Area" shapefile were added to QGIS. Then, the "intersection" tool was used, and from the result obtained from this operation, the area was classified into the five levels of vulnerability.

This is the output of Physical Coastal Vulnerability Index for Geomorphology variable using QGIS along Manjung Coastline:

The second map was created using the socio-economic parameter, and among its variables, the Communication and Transportation Systems variable was selected: *Communication and transportation system variables assess the level of accessibility of an area when a disaster occurs.*
Also this variable was classified into five levels of vulnerability, which correspond to:

	Socioeconomics Parameters	Ranking of Socioeconomic Vulnerability				
		Very Low = 1	Low = 2	Moderate = 3	High = 4	Very High = 5
4	Road Network (3)	2km buffer	1.5 km buffer	1 km buffer	500 m buffer	250 m buffer

To create the map, the "shoreline" shapefile and the " road" shapefile were added to QGIS. Then, the "union" tool was used, and from the result obtained from this operation, the area was classified into the five levels of vulnerability.
This is the output of Socio-Economic Coastal Vulnerability Index for Communication and Transportation Systems variable along Manjung Coastline using QGIS.



Final consideration

Thanks to this project, I was able to learn about the characteristics of Malaysia's coastal territory and the issues related to its vulnerability. Thus, it was an excellent opportunity to reflect on the differences between the Italian and Malaysian coasts and to understand that the problem of coastal vulnerability represents a global emergency not to be underestimated and to be addressed as soon as possible. Therefore, the choice to develop indices for assessing vulnerability is a correct method in approaching the issue and in being able to formulate plans that can mitigate the risks.

Lastly, I would like to thank Vasukey and Shaerra for the support and the help to realize the project.