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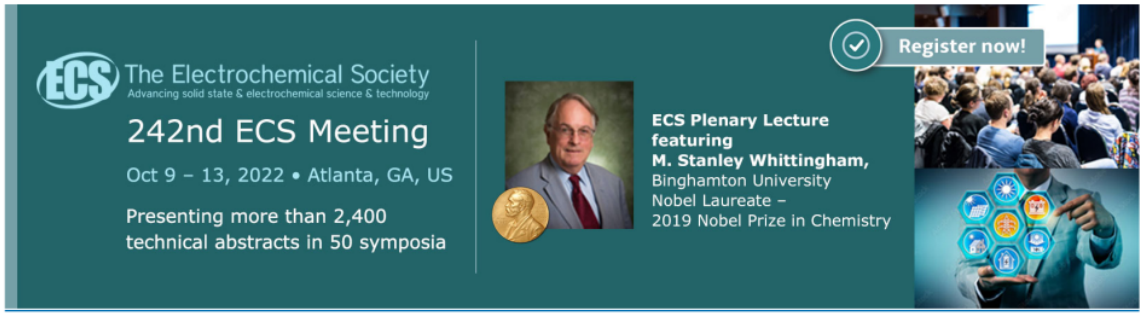

Flood Problem in Pekanbaru City Analysis Using GIS Approach

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Abstract. Pekanbaru City, Riau Province, Indonesia is located at coordinates 0°25'29.20"-0°39'15.22" N and 101°20'43.39"- 101°34'25.60" E. This research aims to study the common causes of flooding in Pekanbaru city which has a good geological condition. This study uses two types of data as primary and secondary data in the form of geomorphological, geological, rainfall and land use data with a geographic information system (GIS) analysis that can help spatial analysis to determine the level of flood disaster vulnerability with visual mapping models. The geomorphological analysis shows 2 types of geomorphological units found: low-land denudational and low-land structural with river flow pattern consisting of dendritic, sub-dendritic and parallel. Rainfall is quite high in 2018 with 2621.5 mm and caused flood-prone areas which are divided into 3 categories: Non vulnerable area (64.575%), Medium Vulnerable area (23,386%) and Vulnerable area (12,039%) from the entire of the research area.

1. Introduction

Pekanbaru is the capital city of Riau Province with a large population on the island of Sumatra, Indonesia. This condition is inseparable from the strategic location of the Pekanbaru City which is located at the centre of Sumatra Island with an area of 632.34 km2 [1]. With a total population of 1.6 million people, Pekanbaru has an average population of 2000 people per kilometre. This is certainly a problem in urban areas. One of them is the problem of flooding for the area surrounding of Pekanbaru City.

The problem of flooding in Pekanbaru City has become a serious thought for officials and spatial experts of Pekanbaru City. Almost every month certain floods routinely happen in Pekanbaru City. Once heavy rain falls, it will not be long before the water puddles like a pool. Lately, rainfall is quite high in December with a value of 16,954 mm accompanied by an extraordinary discharge, so that Pekanbaru is not ready to collect rainfall. As a result, this high rainfall is inundated along the roads and residential areas.

Geologically, Pekanbaru City is in the Central Sumatra Basin which is a back-arc basin that develops along the west and south coast of the Sunda Exposure in Southwestern Southeast Asia. This study built on the formation of Minas, old alluvium, and young alluvium. Based on the Geological Map of Pekanbaru Sheet in the study area are in three formations [2]. These formations are Minas formation, old alluvium, and young alluvium. This alluvial unit consists of river sediment (sand,

gravel, limestone, and claystone) and beach sediment, ie, sand to mud. The thickness of the alluvial unit is estimated at 20 meters.

2. Methodology

The flooding effect in an urban area is an important concern in this study to determine the cause, such as the influence of general geological conditions, the effect of watershed relations and rainfall on the problem of flooding, and the influence of land use on floods [3]. These data become a reference to measure and obtain the values of the geological influence on floods that occur in Pekanbaru City. With sufficient equipment, primary data collection in the field did not experience significant obstacles. The equipment used is GPS, topographic maps, compass, camera, and drone or Unmanned Aerial Vehicle (UAV) [4]-[8]. While secondary data used are geological map data containing lithological and structural information [9], land use data, rainfall data [10] and information about flood events from affected residents (by interview).

3. Result and Discussion

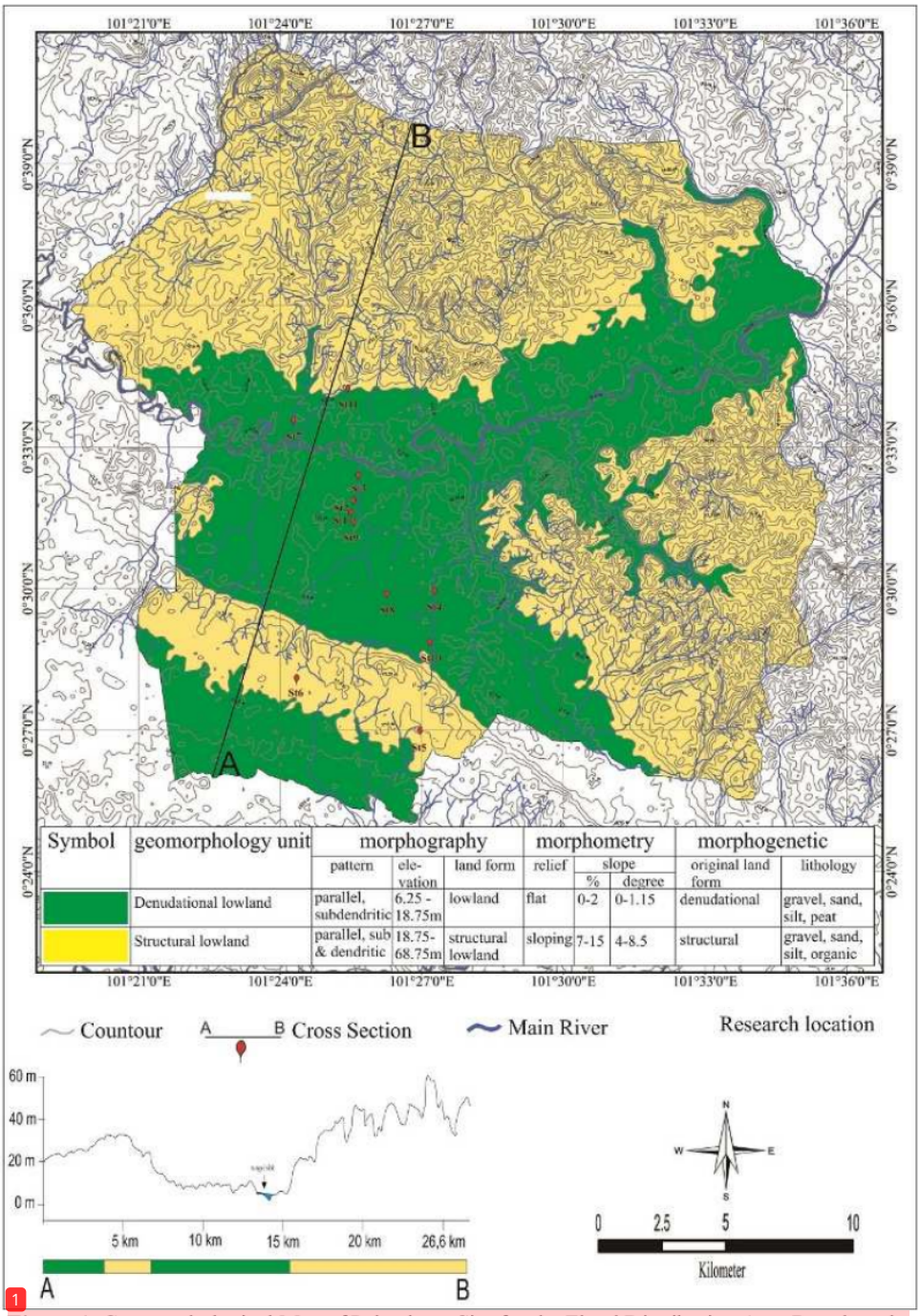
In terms of topographical conditions, Pekanbaru is around 5-20 meter above sea level (masl) and in geological structure, Pekanbaru is an anticline fold area with the lower wing at each end of the left and right side which is a large river, namely Siak River and Kampar Kiri River, so logically, Pekanbaru will not experience flooding. But this is the opposite when heavy rains occur even if only for a short time.

The results of the geomorphological analysis show the morphography, morphometry and morphogenetics of Pekanbaru are divided into 2; denudational lowland geomorphological unit and structural lowland geomorphological unit. Denudational lowland unit have an elevation of 6.25 - 18.75 meters above sea level with relatively flat relief (slope range 0^0-$1{,}15^0$). The geological process that predominates in the formation of geomorphological unit is a denudational process in which almost all fields have been broken down into loose sedimentary material and soil. This geomorphological unit covers 45% of the city of Pekanbaru. In this unit, the predominant flow patterns are dendritic and sub-dendritic flow patterns. Other geomorphological units are structural lowland geomorphological which cover 55% of Pekanbaru. This geomorphology unit is characterized by an elevation of 18.75 - 68.75 meters above sea level.

The slope of the morphometric calculation results in this unit is 4^0 - 8.5^0 with gentle relief. This landform was formed because of the geological structure in the form of folds so that the heights and valleys are formed even though the slope is relatively sloping. This shows that the dominant geological process forming this land is a structural process. In this unit, the dominant flow pattern is a parallel flow pattern because there are valleys between high elevations. So it can be concluded that the relationship between geomorphology and flooding is that if high intensity of rainfall at the low geomorphological area, the water will flow to a low topography i.e. in denudational lowland geomorphological unit with a slope of 0-1.5^0 (Figure 1).

The results of mapping analysis using drone or UAV show that flood events that occurred on Jalan Umban Sari, Rumbai District (Figure 2), showed that flooding was caused by heavy rainfall that occurred at 2 am to 6 am and the overflow of water from the drainage around the road was due to the thickness sand sediment in the drainage or shallow siltation and also the drainage condition in the area is not good. The flood height in this area reaches 30 cm.

Rainfall data in the city of Pekanbaru based on the Meteorological, Climatological, and Geophysical Agency of The Republic of Indonesia (BMKG) 2018 showed the lowest rainfall in April with an average of 3.47 mm and the highest rainfall occurred in December with an average of 16,954 mm. In October to December the rainfall range is 9,432-16,954 mm and the highest number of rainy days is along 17-25 days throughout the year of 2018. Overall, Pekanbaru City throughout 2018 had experienced 176 days with a total rainfall of 2621.5 mm.



Symbol	geomorphology unit	morphography			morphometry			morphogenetic	
		pattern	ele-vation	land form	relief	slope %	slope degree	original land form	lithology
	Denudational lowland	parallel, subdendritic	6.25 - 18.75m	lowland	flat	0-2	0-1.15	denudational	gravel, sand, silt, peat
	Structural lowland	parallel, sub & dendritic	18.75-68.75m	structural lowland	sloping	7-15	4-8.5	structural	gravel, sand, silt, organic

Figure 1. Geomorphological Map of Pekanbaru City for the Flood Distribution Area Based on the Analysis of Geological Condition

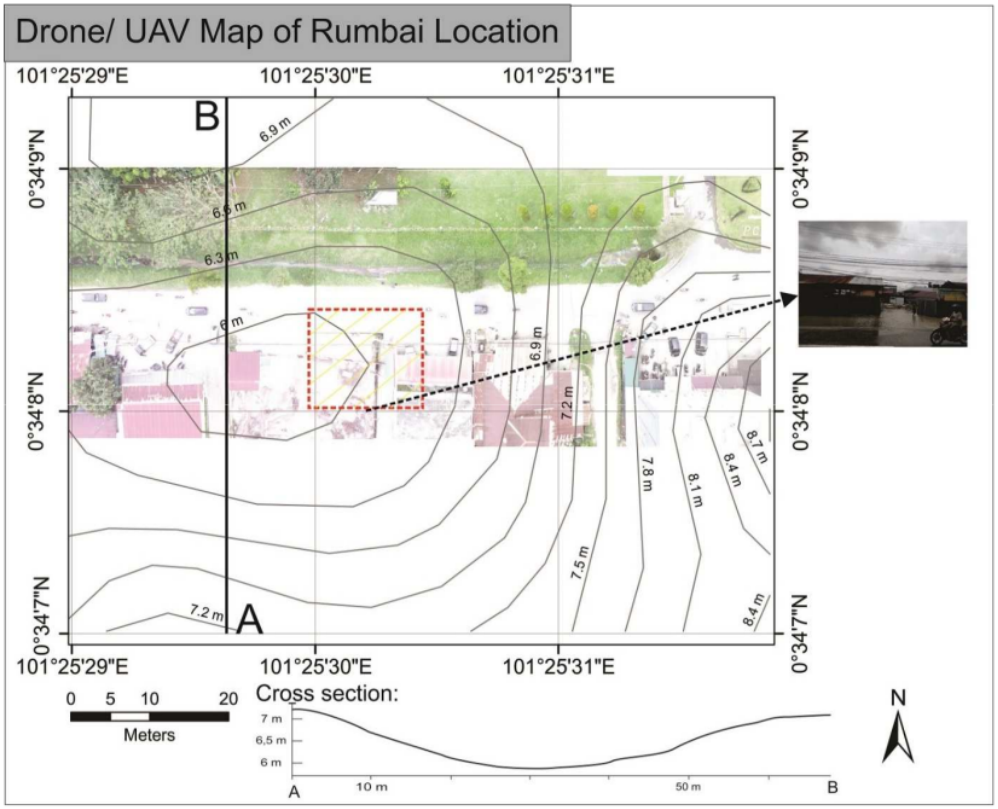


Figure 2. The Result of Drone/ UAV Map from the Potential Flood Area on Jalan Umban Sari, Rumbai District, Pekanbaru City

4. Conclusion

The study shows the flood problem in Pekanbaru city caused by the rainfall, which affected by the human interrupt such as the drainage system and the population. Another problem of flooding observed at the observation station is influenced by low topography with a slope of 0 ° -1.5 ° that forms a basin. In general, the cause of the flooding is caused by poor drainage, thick sediment, and garbage. At the same time, the other common problem lies in the position of the flood, which is remarkably close to the main river so that the flood is affected by the overflowing river water level. Flood observation stations generally located above the Old Alluvium Formation, which has a reasonably excellent or moderate absorption rate, but this condition does not affect flooding much. Still, the problem of flooding is influenced by land cover areas that are densely populated, resulting in a lack of catchment areas.

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