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Increasing Disaster Awareness of the Community by Flood Potential Mapping of Densely-Populated Urban River Watershed in South and West Jakarta with LIDAR Data Segmentation

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Abstract

Degradation of environment quality is currently the prime cause of the recent occurrence of natural disasters; it also contributes in the increase of the area that is prone to natural disasters. This research is aimed to map the potential of areas around Pesanggrahan river in DKI Jakarta by segmenting the Digital Elevation Model derived from LIDAR data. The objective of this segmentation is to find the watershed lines of the DEM image. Data processing in this research is using LIDAR data which take the ground surface data, which is overlaid with Jakarta river map and subsequently, the data is then segmented the image. The expected result of the research is the flood potential area information, especially along the Pesanggrahan river in South Jakarta.

Key words: Flood mapping, Urban flood potential, LIDAR, image segmentation, Digital Surface Model, Digital Elevation Model

Introduction

Rapid growth of Jakarta city without adequate water supply system causes high usage of sub-surface water which in turn causes land subsidence. This condition is also complicated by the degradation of the city's drainage and sewer system, including downtown rivers. In addition, flooding is a phenomenon that almost always happens every year in Jakarta. One aspect that is often overlooked is that the flood is closely related to the unity of the so-called watershed (*Daerah Aliran Sungai* or DAS) [1]. In addition to flooding, problems that occur in the watershed include increased erosion and sedimentation, reduced land productivity, and acceleration of land degradation and river water pollution [2]. This study aims to map flood-prone areas based on 5-year flood data that can clarify water level rise by using remote sensing data in the form of Digital Surface Model data as any existing surface shape such as tree height, buildings and any objects on the ground. The expected result of this study is to compare the results of the DSM data segmentation as which will produce accurate data on the prediction of the flood.

Method of Experiment

Flood mapping method is done by using DSM (Digital Surface Model) data of DKI Jakarta which is result of contour data processing of Jakarta. DSM data is segmented by watershed segmentation method to get predicted flood potential. The expected output of this process is information on potential floods along the Pesanggrahan River Basin located in South Jakarta Municipality [3]. DSM data as main data is processed by using ArcGIS application to get contour data and ground surface height. The results are then correlated to obtain the image of land cover in the Pesanggrahan area. After correlation processing results, the data were analyzed with field data of flood distribution. The expected output of this process is information on potential flooding along Pesanggrahan River Basin located in Pesanggrahan Sub district.

The methods used in this study include surface height extraction from DSM data, incorporation of river map data with ground level data obtained from DSM data, and object classification with watershed segmentation technique on DSM data. In this study, the data used is digital data from the height of the surface (Digital Surface Model / DEM) in 2016 with a resolution of 1 meter. Fig.1 shows the map of the sub-district administrations in DKI Jakarta whose boundaries are represented by the color difference. DKI Jakarta is categorized as a delta city, a city located at the mouth of a river that is generally below sea level, and quite vulnerable to climate change. Nevertheless, the existence of rivers and seas causes a delta city to have a strategic advantage, especially in terms of water transport. The delta city is generally below sea level, and quite vulnerable to climate change.

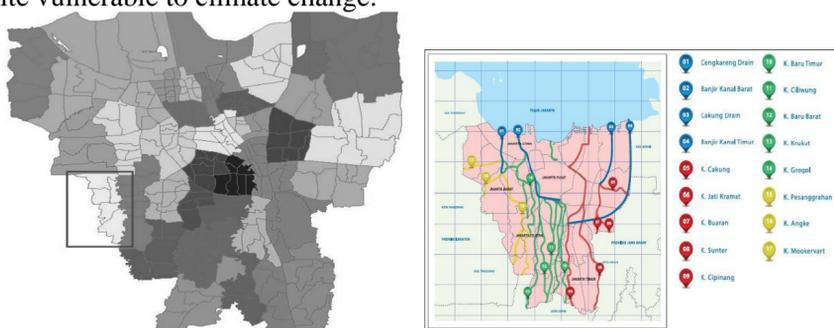


Fig. 1. DKI Jakarta District boundary and river map

Result and Discussion

From DEM data processing, we can get description of land surface height Pesanggrahan area. Figure 6 shows the results of the altitude data processing. The elevation of the soil surface in Pesanggrahan Region is relatively homogeneous because it is a flat area. From the results of the processed data, Pesanggrahan area is divided into light green color shows height between 5m-10m, light yellow color has a height of 10-15 m, 15-20 m long yellow, pink color has a height of 20-25 m, dark red has a height of 25m-30m, and the color purple has a height of more than 30 m.

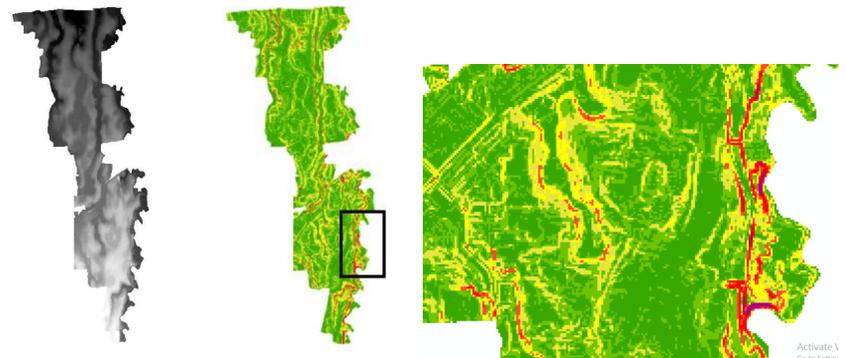


Fig. 2. LIDAR data and Elevation data from LIDAR

The ground level data in Fig. 4 is then combined with the contour data from Fig. 5 to obtain the surface height description with soil contour data. The result of the merging is shown in Figure 6. From the image of the merging of the line height (contour) and the height of the soil surface has a contour line density which means it reflects the steep slope against the surface. Yellow color is the river, and white area shows the lowermost elevation that is very prone to flooding.

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