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Geomorphology and Flood Analysis Using Light Detection and Ranging

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Abstract : The natural landscape of the Philippine archipelago plus the current realities of climate change make the country vulnerable to flood hazards. Flooding becomes the recurring natural disaster in the country resulting to lose of lives and properties. Musimusi is among the rivers which exhibited inundation particularly at the inhabited floodplain portion of its watershed. During the event, rescue operations and distribution of relief goods become a problem due to lack of high resolution flood maps to aid local government unit identify the most affected areas. In the attempt of minimizing impact of flooding, hydrologic modelling with high resolution mapping is becoming more challenging and important. This study focused on the analysis of flood extent as a function of different geomorphologic characteristics of Musimusi watershed. The methods include the delineation of morphometric parameters in the Musimusi watershed using Geographic Information System (GIS) and geometric calculations tools. Digital Terrain Model (DTM) as one of the derivatives of Light Detection and Ranging (LiDAR) technology was used to determine the extent of river inundation involving the application of Hydrologic Engineering Center-River Analysis System (HEC-RAS) and Hydrology Modelling System (HEC-HMS) models. The digital elevation model (DEM) from synthetic Aperture Radar (SAR) was used to delineate watershed boundary and river network. Datasets like mean sea level, river cross section, river stage, discharge and rainfall were also used as input parameters. Curve number (CN), vegetation, and soil properties were calibrated based on the existing condition of the site. Results showed that the drainage density value of the watershed is low which indicates that the basin is highly permeable subsoil and thick vegetative cover. The watershed's elongation ratio value of 0.9 implies that the floodplain portion of the watershed is susceptible to flooding. The bifurcation ratio value of 2.1 indicates higher risk of flooding in localized areas of the watershed. The circularity ratio value (1.20) indicates that the basin is circular in shape, high discharge of runoff and low permeability of the subsoil condition. The heavy rainfall of 167 mm brought by Typhoon Seniang last December 29, 2014 was characterized as high intensity and long duration, with a return period of 100 years produced 316 m3s-1 outflows. Portion of the floodplain zone (1.52%) suffered inundation with 2.76 m depth at the maximum. The information generated in this study is helpful to the local disaster risk reduction management council in monitoring the affected sites for more appropriate decisions so that cost of rescue operations and relief goods distribution is minimized.

Keywords : flooding, geomorphology, mapping, watershed
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