

UAV-Based Hydrological Modeling and Drainage Assessment of an Institutional Catchment in Southeastern Nigeria

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Key words: GNSS/GPS; Photogrammetry; Keyword 1; Keyword 2; Keyword 3; UAV, DEM, hydrological modeling, Federal Polytechnic Nekede, runoff/discharge.

SUMMARY

Abstract

High-resolution topographic data are transforming small-catchment hydrological analysis. This paper presents a complete workflow for hydrological modelling of the Federal Polytechnic Nekede catchment (Owerri area, Southeastern Nigeria) that uses an unmanned aerial vehicle (UAV) to produce a high-resolution Digital Elevation Model (DEM), then couples that DEM to a lumped/distributed hydrological model to simulate runoff and streamflow. This study presents a hydrological modeling approach for the Federal Polytechnic Nekede catchment using a UAV-derived Digital Elevation Model (DEM) integrated with Global Mapper and the Rational Method. The UAV photogrammetry produced a 5 m-resolution DEM, enabling detailed watershed delineation, slope analysis, and flow network extraction. Six subcatchments were identified, with time of concentration values ranging from 34.9 – 93.6 minutes and corresponding peak discharges between 0.67 – 5.01 m³/s for 25-, 50-, and 100-year design storms. Compared to coarser DEMs, the UAV-derived data captured micro-drainage features and improved hydrological accuracy. A 20% adjustment factor was applied to account for future urbanization and climate variability amounting to peak discharges between 0.8 – 6.01 m³/s for 25, 50, and 100-year design storms. The study highlights the potential of UAV-based topographic mapping as a reliable, effective tool for urban flood assessment, stormwater design, and sustainable drainage planning in rapidly developing regions.

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