Leveraging Low-Cost Geospatial Technology for Sustainable Resource Management: A UAV and GNSS Approach for Stockpile Auditing in Nigeria

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Key words: Engineering survey; Geoinformation/GI; GNSS/GPS; Low cost technology; Mine surveying; Photogrammetry; Positioning; Quantity surveying; Remote sensing; Spatial planning; Young surveyor

SUMMARY

The global push towards achieving the Sustainable Development Goals (SDGs) requires innovative, cost-effective, and safe methods for managing natural resources. Accurate auditing of extractive resources, like coal, is fundamental to ensuring responsible consumption (SDG 12), supporting resilient infrastructure (SDG 9), and promoting safe working environments (SDG 8). This paper addresses the challenge of deploying advanced geospatial intelligence in developing economies by evaluating low-cost Unmanned Aerial Vehicles (UAVs) as a sustainable alternative to traditional survey methods for volumetric analysis. We present a comparative study from a mining site in Kogi State, Nigeria, where the volume of a coal stockpile was measured using two distinct methods: a conventional ground-based GNSS RTK system and a prosumer-grade UAV (DJI Mavic 2 Pro). The study reveals that the UAV-derived volume (3064.10 m^3) and the GNSS-derived volume (2978.61 m^3) have a minimal percentage difference of 2.79%, which falls well within the legitimate error margin of ±3%. Critically, the UAV method drastically reduced on-site data acquisition time and eliminated the need for personnel to physically climb the stockpile, significantly enhancing operational safety. This research demonstrates that accessible geospatial technology can provide the timely and precise data required for robust resource governance. By democratizing access to high-accuracy surveying, low-cost UAVs catalyze sustainable development, enabling mining operations to improve efficiency, ensure regulatory compliance, and build a resilient future in line with "The Future We Want – The SDGs and Beyond."