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Revolutionizing Oil Palm Replanting: Geospatial Terrace Design for High-precision Ground Implementation Compared to Conventional Methods

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Abstract : Replanting in oil palm cultivation is vital to enable the introduction of planting materials and provides an opportunity to improve the road, drainage, terrace design, and planting density. Oil palm replanting is fundamentally necessary every 25 years. The adoption of the digital replanting blueprint is imperative as it can assist the Malaysia Oil Palm industry in addressing challenges such as labour shortages and limited expertise related to replanting tasks. Effective replanting planning should commence at least 6 months prior to the actual replanting process. Therefore, this study will help to plan and design the replanting blueprint with high-precision translation on the ground. With the advancement of geospatial technology, it is now feasible to engage in thoroughly researched planning, which can help maximize the potential yield. A blueprint designed before replanting is to enhance management's ability to optimize the planting program, address manpower issues, or even increase productivity. In terrace planting blueprints, geographic tools have been utilized to design the roads, drainages, terraces, and planting points based on the ARM standards. These designs are mapped with location information and undergo statistical analysis. The geospatial approach is essential in precision agriculture and ensuring an accurate translation of design to the ground by implementing high-accuracy technologies. In this study, geospatial and remote sensing technologies played a vital role. LiDAR data was employed to determine the Digital Elevation Model (DEM), enabling the precise selection of terraces, while ortho imagery was used for validation purposes. Throughout the designing process, Geographical Information System (GIS) tools were extensively utilized. To assess the design's reliability on the ground compared with the current conventional method, high-precision GPS instruments like EOS Arrow Gold and HIPER VR GNSS were used, with both offering accuracy levels between 0.3 cm and 0.5cm. Nearest Distance Analysis was generated to compare the design with actual planting on the ground. The analysis revealed that it could not be applied to the roads due to discrepancies between actual roads and the blueprint design, which resulted in minimal variance. In contrast, the terraces closely adhered to the GPS markings, with the most variance distance being less than 0.5 meters compared to actual terraces constructed. Considering the required slope degrees for terrace planting, which must be greater than 6 degrees, the study found that approximately 65% of the terracing was constructed at a 12-degree slope, while over 50% of the terracing was constructed at slopes exceeding the minimum degrees. Utilizing blueprint replanting promising strategies for optimizing land utilization in agriculture. This approach harnesses technology and meticulous planning to yield advantages, including increased efficiency, enhanced sustainability, and cost reduction. From this study, practical implementation of this technique can lead to tangible and significant improvements in agricultural sectors. In boosting further efficiencies, future initiatives will require more sophisticated techniques and the incorporation of precision GPS devices for upcoming blueprint replanting projects besides strategic progression aims to guarantee the precision of both blueprint design stages and its subsequent implementation on the field. Looking ahead, automating digital blueprints are necessary to reduce time, workforce, and costs in commercial production.

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