

## INTISARI

### **Aplikasi Metode Mixed Effect Random Forest dan Light Gradient Boosting Machine Regression pada Optimasi Waktu Operasi Pabrik Kelapa Sawit yang Adaptif Terhadap Hasil Panen**

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Ketidakpastian distribusi panen kelapa sawit di PT Astra Agro Lestari Tbk dapat menyebabkan ketidakseimbangan dalam pengangkutan dan pengolahan, sehingga memengaruhi efisiensi operasional serta kualitas minyak sawit. Oleh karena itu, prediksi panen per menit yang akurat sangat diperlukan untuk mendukung perencanaan logistik dan simulasi jam olah pabrik. Penelitian ini bertujuan untuk membandingkan performa dua pendekatan pemodelan, yaitu *Mixed Effects Random Forest* (MERF) dan *Light Gradient Boosting Machine Regressor* (LGBMR) dalam memprediksi persentase panen harian. Penelitian difokuskan pada data panen harian di PT Astra Agro Lestari Tbk untuk periode 2 Januari 2024 hingga 30 September 2024, mencakup 3.024.501 observasi dengan variabel seperti lokasi panen, alat angkut, waktu, dan tonase. Berdasarkan hasil evaluasi performa model, diperoleh kesimpulan bahwa LGBMR mampu menghasilkan prediksi panen per menit yang lebih stabil dan akurat daripada MERF yang cenderung *overfitting*, dengan  $R^2 = 0,8893$ , RMSE = 8,72, MAE = 6,43, dan MAPE = 18,79% pada data uji. Hasil prediksi LGBMR digunakan untuk mengoptimalkan jadwal pengangkutan dan simulasi jam olah, menentukan waktu pengolahan optimal guna menjaga keseimbangan stok dan efisiensi produksi. Dengan demikian, LGBMR direkomendasikan sebagai model prediksi panen yang tepat untuk mendukung operasional perkebunan kelapa sawit.

## ABSTRACT

### **The Application of Mixed Effect Random Forest and Light Gradient Boosting Machine Regression Methods on the Adaptive Palm Oil Mill Operation Time Optimization Due to Harvest Yield**

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Uncertainty in the distribution of oil palm harvests at PT Astra Agro Lestari Tbk can lead to imbalances in transportation and processing, thereby affecting operational efficiency and the quality of palm oil. Therefore, accurate per-minute harvest prediction is essential to support logistics planning and processing time simulations at the mill. This study aims to compare the performance of two modeling approaches, namely Mixed Effects Random Forest (MERF) and Light Gradient Boosting Machine Regressor (LGBMR), in predicting daily harvest percentages. The study focuses on daily harvest data at PT Astra Agro Lestari Tbk for the period from January 2, 2024, to September 30, 2024, encompassing 3,024,501 observations with variables such as harvest location, transportation equipment, time, and tonnage. Based on model performance evaluation, it was concluded that LGBMR produces more stable and accurate per-minute harvest predictions than MERF, which tends to overfit, with  $R^2 = 0.8893$ , RMSE = 8.72, MAE = 6.43, and MAPE = 18.79% on the test data. The LGBMR predictions are used to optimize transportation schedules and processing time simulations, determining the optimal processing time to maintain stock balance and production efficiency. Therefore, LGBMR is recommended as an appropriate harvest prediction model to support the operational activities of oil palm plantations.