Peramalan Harga Biji Kakao di Indonesia menggunakan Hybrid ARIMAX-LSTM dengan Optimasi Parameter Melalui Grid Search = Cocoa Bean Price Forecasting in Indonesia using a Hybrid ARIMAX-LSTM Model with Parameter Optimization via Grid Search

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Abstrak

Harga biji kakao lokal di Indonesia melonjak tajam dari sekitar Rp28.000/kg menjadi lebih dari Rp56.000/kg antara awal 2023 hingga awal 2024, seiring kenaikan harga global dari USD2.500/MT ke USD4.000/MT. Fluktuasi ini menjadi tantangan besar bagi industri dan pembuat kebijakan karena berdampak pada stabilitas rantai pasok dan pendapatan petani. Untuk menjawabnya, penelitian ini mengembangkan model peramalan harga berbasis hybrid antara Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) dan Long Short-Term Memory (LSTM), guna menangkap pola linier dan nonlinier dalam data deret waktu. Data mencakup periode Januari 2016–Desember 2023, termasuk harga kakao domestik dan global, nilai tukar USD/IDR, inflasi, volume ekspor-impor, dan produksi. Model ARIMAX dioptimasi dengan grid search, sementara LSTM menggunakan Bayesian optimization. Hasil terbaik diperoleh dari Hybrid ARIMAX-LSTM dengan pendekatan simple holdout, menunjukkan akurasi tinggi (MAE: 1.721, RMSE: 2.376, MAPE: 3,72%). Temuan ini memberikan kontribusi strategis dalam mendukung ketahanan industri kakao, khususnya untuk penentuan waktu optimal dalam pengadaan bahan baku.

.....The price of local cocoa beans in Indonesia rose sharply from approximately IDR 28,000/kg to overcIDR 56,000/kg between early 2023 and early 2024, following an increase in global cocoa prices from USD 2,500/MT to USD 4,000/MT. This volatility presents a significant challenge for industry players and policymakers, as it affects supply chain stability and farmers' income. To address this issue, this study develops a hybrid price forecasting model that combines Autoregressive Integrated Moving Average with Exogenous Variables (ARIMAX) and Long Short-Term Memory (LSTM), aiming to capture both linear and nonlinear patterns in time series data. The dataset covers the period from January 2016 to December 2023 and includes domestic and global cocoa prices, USD/IDR exchange rates, inflation, export-import volumes, and production figures. The ARIMAX model is optimized using grid search, while the LSTM model is tuned using Bayesian optimization. The best-performing model, the Hybrid ARIMAX-LSTM with a simple holdout approach, demonstrates high predictive accuracy (MAE: 1,721; RMSE: 2,376; and MAPE of 3.72%). These findings offer strategic value in providing data-driven decision support tools to enhance the resilience of the national cocoa industry, particularly in determining optimal timing for raw material procurement.