IMPLEMENTASI *LSTM* UNTUK PREDIKSI KONSUMSI KALORI HARIAN BERDASARKAN DATA NERACA BAHAN MAKANAN KEMENTERIAN PERTANIAN

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ABSTRAK

Ketahanan pangan merupakan isu kritis bagi Indonesia yang menempati peringkat ke-69 dari 113 negara pada *Global Food Security Index* 2022. Metode prediksi konvensional seperti regresi linear dan penghalusan eksponensial tunggal memiliki akurasi terbatas dengan MAPE 15-20% serta tidak mampu menangkap pola temporal konsumsi pangan yang dipengaruhi oleh faktor musiman, krisis ekonomi, dan perubahan iklim. Penelitian ini bertujuan mengembangkan model *machine learning* untuk memprediksi konsumsi kalori per kapita berdasarkan data Neraca Bahan Makanan Indonesia dengan target akurasi MAPE di bawah 10%. Penelitian menggunakan metodologi CRISP-DM meliputi tahapan *Business Understanding*, *Data Understanding*, *Data Preparation*, *Modeling*, *Evaluation*, dan *Deployment*. Data NBM periode 1993-2024 sebanyak 48.696 baris mencakup 112 komoditas diolah menjadi 39 fitur prediktif. Empat model dikembangkan yaitu LSTM, XGBoost, HuberRegressor, dan LSTM *Enhanced Ensemble* dengan bobot optimal 90:5:5. Hasil evaluasi menunjukkan LSTM *Enhanced Ensemble* mencapai performa terbaik dengan MAE 773,21 ton, RMSE 1.815,99 ton, MAPE 3,72%, dan R^2 0,9898. Model ini melampaui target penelitian dan menjelaskan 98,98% variasi konsumsi kalori. Model diintegrasikan ke dalam sistem informasi berbasis *web* menggunakan arsitektur *microservices* dengan Laravel 11, FastAPI, dan Docker.

Kata Kunci: *Ketahanan Pangan, LSTM, Machine Learning, Neraca Bahan Makanan, Prediksi Konsumsi Kalori, Time Series Forecasting*

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ABSTRACT

Food security is a critical issue for Indonesia, ranking 69th out of 113 countries in the Global Food Security Index 2022. Conventional prediction methods such as linear regression and single exponential smoothing have limited accuracy with MAPE of 15-20% and are unable to capture temporal patterns of food consumption influenced by seasonal factors, economic crises, and climate change. This study aims to develop a machine learning model to predict per capita calorie consumption based on Indonesia's Food Balance Sheet data with a target accuracy of MAPE below 10%. The research uses the CRISP-DM methodology covering Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation, and Deployment stages. Food Balance Sheet data from 1993-2024 comprising 48,696 rows covering 112 commodities were processed into 39 predictive features. Four models were developed: LSTM, XGBoost, HuberRegressor, and LSTM Enhanced Ensemble with optimal weights of 90:5:5. Evaluation results show that LSTM Enhanced Ensemble achieved the best performance with MAE of 773.21 thousand tons, RMSE of 1,815.99 thousand tons, MAPE of 3.72%, and R^2 of 0.9898. This model exceeded the research target and explained 98.98% of calorie consumption variation. The model was integrated into a web-based information system using microservices architecture with Laravel 11, FastAPI, and Docker.

Keywords: *Calorie Consumption Prediction, Food Balance Sheet, Food Security, LSTM, Machine Learning, Time Series Forecasting*