

ABSTRAK

Tebu (*Saccharum officinarum*) merupakan tanaman penghasil gula yang penting dalam industri gula Indonesia. Penentuan kelayakan giling batang tebu berdasarkan kadar gula (nilai Brix) sangat krusial untuk memastikan kualitas bahan baku optimal. Batang tebu dengan $\text{Brix} \geq 16\%$ dianggap layak digiling, sedangkan $\text{Brix} < 16\%$ menunjukkan kualitas kurang baik. Namun, proses penentuan ini memakan waktu dan bergantung pada keahlian tenaga kerja. Penelitian ini bertujuan mengembangkan sistem klasifikasi otomatis kelayakan giling batang tebu berdasarkan citra menggunakan *Convolutional Neural Network* (CNN) dengan *transfer learning*.

Dataset penelitian terdiri dari 16.532 citra batang tebu varietas Bululawang yang diklasifikasikan menjadi dua kategori, layak giling ($\text{Brix} \geq 16\%$) dan tidak layak giling ($\text{Brix} < 16\%$). Metodologi penelitian mencakup *preprocessing* citra, pelatihan model CNN dengan arsitektur VGG19 dan ResNet50 menggunakan *transfer learning*, serta evaluasi kinerja model melalui pengujian berbagai kombinasi *hyperparameter* meliputi *epoch*, *optimizer*, dan teknik *fine tuning*. Dua pendekatan pelatihan diterapkan, pelatihan perkategori dan pelatihan menggunakan semua kategori sekaligus.

Hasil penelitian menunjukkan ResNet50 mencapai performa terbaik dengan akurasi 87,87% pada pelatihan semua kategori dan pelatihan perkategori menghasilkan akurasi 80,29%, mengungguli VGG19 yang mencapai akurasi 79,81% pada pelatihan semua kategori dan pada pelatihan perkategori menghasilkan akurasi 79,11%. Model dengan performa terbaik diimplementasikan dalam aplikasi web berbasis *Streamlit* untuk memudahkan petani dan pelaku industri dalam melakukan klasifikasi secara *real-time*. Penelitian ini memberikan kontribusi signifikan dalam pengembangan teknologi pertanian presisi yang dapat meningkatkan efisiensi operasional dan akurasi penentuan kelayakan giling tebu, serta mendukung keberlanjutan industri gula Indonesia.

Kata Kunci: Klasifikasi Tebu, CNN, VGG19, ResNet50, Nilai Brix.

ABSTRACT

*Sugarcane (*Saccharum officinarum*) is an important sugar-producing crop in the Indonesian sugar industry. Determining the milling eligibility of sugarcane stalks based on sugar content (Brix value) is crucial to ensure optimal raw material quality. Sugarcane stalks with a Brix value $\geq 16\%$ are considered suitable for milling, while those with Brix $< 16\%$ indicate lower quality. However, this determination process is time-consuming and highly dependent on human expertise. This study aims to develop an automatic classification system for sugarcane milling eligibility based on image data using a Convolutional Neural Network (CNN) with transfer learning.*

The dataset used in this study consists of 16,532 images of Bululawang variety sugarcane stalks, classified into two categories: suitable for milling (Brix $\geq 16\%$) and unsuitable for milling (Brix $< 16\%$). The research methodology includes image preprocessing, CNN model training using VGG19 and ResNet50 architectures with transfer learning, and performance evaluation through experiments with various hyperparameter combinations, including epochs, optimizers, and fine-tuning techniques. Two training approaches were applied: category-based training and training using all categories simultaneously.

The results show that ResNet50 achieved the best performance, with an accuracy of 87.87% in the all-category training scenario, while category-based training achieved an accuracy of 80.29%, outperforming VGG19, which reached an accuracy of 79.81% in all-category training and 79.11% in category-based training. The best-performing model was implemented in a Streamlit-based web application to facilitate real-time classification for farmers and industry stakeholders. This study contributes significantly to the development of precision agriculture technologies by improving operational efficiency and the accuracy of sugarcane milling eligibility determination, thereby supporting the sustainability of the Indonesian sugar industry.

Keywords: *Sugarcane Classification, CNN, VGG19, ResNet50, Brix Value.*