

ABSTRACT

The national sugar industry has faced significant challenges in recent years, including a 7.01% decline in production in 2023 (BPS, 2023). One major contributing factor is the low efficiency of post-harvest operations, particularly in the quality classification of sugarcane stalks, which is still performed manually. This manual process often leads to inconsistencies in assessment and can result in trust issues between farmers and field officers. Furthermore, inaccurate classification increases the need for additional cleaning processes, thereby raising the company's operational costs. This study develops a deep learning-based sugarcane quality classification system using a two-stage approach. The first stage utilizes YOLOv11 for sugarcane stalk detection, while the second stage employs EfficientNet to classify stalk quality into five categories. A dataset from PT Sinergi Gula Nusantara (PT SGN) was processed using the Knowledge Discovery in Databases (KDD) approach, incorporating techniques such as augmentation, data splitting, and image resizing. The results show that YOLOv11 achieved an accuracy of 93.8%, a precision of 95.7%, recall of 94.4%, mAP@0.5 of 97.8%, and mAP@0.5:0.95 of 89.4%. Among the four EfficientNet variants tested (B0–B3), EfficientNet-B2 with fine-tuning achieved the highest accuracy of 88.57%. The system demonstrated strong generalization capabilities against visual disturbances such as complex backgrounds and uneven lighting, although performance slightly decreased under extreme conditions. These findings confirm that the system effectively enhances the accuracy, efficiency, and objectivity of the classification process. For future development, it is recommended to expand the dataset to include a wider range of lighting conditions, apply advanced preprocessing techniques, and conduct field testing to ensure the system's adaptability in real-world scenarios.

Keywords—Deep Learning, EfficientNet, KDD, Sugarcane Quality Classification, YOLOv11