

Classification of Diseases in Oil Palm Leaves Using the GoogLeNet Model

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Abstract

The general health of palm trees, encompassing the roots, stems, and leaves, significantly impacts palm oil production, therefore, meticulous attention is needed to achieve optimal yield. One of the challenges encountered in sustaining productive crops is the prevalence of pests and diseases afflicting oil palm plants. These diseases can detrimentally influence growth and development, leading to decreased productivity. Oil palm productivity is closely related to the conditions of its leaves, which play a vital role in photosynthesis. This research employed a comprehensive dataset of 1,230 images, consisting of 410 showing leaves, another 410 depicting bagworm infestations, and an additional 410 displaying caterpillar infestations. Furthermore, the major objective was to formulate a deep learning model for the identification of diseases and pests affecting oil palm leaves, using image analysis techniques to facilitate pest management practices. To address the core problem under investigation, the GoogLeNet deep learning approach was applied, alongside various hyperparameters. The classification experiments were executed across 16 trials, each capped at a computational timeframe of 10 minutes, and the predominant duration spanned from 2 to 7 minutes. The results, particularly derived from the superior performance in Model 4 (M4), showed evaluation accuracy, precision, recall, and F1-score rates of 93.22%, 93.33%, 93.95%, and 93.15%, respectively. These were highly satisfactory, warranting their application in oil palm companies to enhance the management of pest and disease attacks.

Keywords: GoogLeNet, Hyperparameter, Oil palm, Palm leaves, Palm diseases

Introduction

The oil palm industry plays an essential role in the economy, while its product serves as a fundamental ingredient in cooking oil and enhances communal welfare through exportation which creates more employment opportunities. In 2016, Indonesia exported 24.15 million tons of crude palm oil (CPO) for USD 14,744 million¹, surpassing the value of all other commodities sold. The oil palm plantation sector provides livelihoods for approximately 16.2 million citizens, constituting a primary source of income. To sustain the quality and quantity of palm

oil yield, the plantation industry is striving to meet environmental standards².

Since 2008, Indonesia has become the largest producer and exporter of palm oil worldwide. The surge in global demand for vegetable oil during the 1990s catalyzed the expansion of plantations cultivated due to their lucrative nature. The distribution of large-scale compared to smallholder plantations is 60% higher, with the majority being located across regions such as Kalimantan and Sumatra Islands, and more recently in Papua. This transition rendered palm oil a crucial agricultural