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MATLAB-Based Simulation Framework for Agro-Waste Conversion to Bioenergy and Bioproducts

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Abstract

The agricultural sector generates substantial amounts of waste, posing significant environmental and economic challenges. The present work proposes a theoretical framework for valorizing agro-waste into bioenergy and bioproducts using MATLAB simulations. By modelling and simulating various conversion technologies, such as anaerobic digestion, fermentation, and pyrolysis, MATLAB can be used to predict process outcomes, optimize operating conditions, and identify potential bottlenecks. This theoretical approach can help evaluate the feasibility of different agro-waste valorization pathways, including the production of biofuels, biogas, bio-oil, bioplastics, biochemicals, and biofertilizers. The use of MATLAB simulations can facilitate the design and optimization of bioprocesses, reducing the need for experimental trials and accelerating the development of sustainable agro-waste valorization systems. This paper discusses the theoretical foundations of agro-waste valorization, highlighting the potential benefits and challenges associated with using MATLAB simulations to model and optimize these systems. The findings of this research work suggest that a theoretical approach using MATLAB can provide valuable insights into the design and operation of agro-waste valorization systems, contributing to a more sustainable and circular economy. By optimizing process conditions and predicting process outcomes, MATLAB simulations can help reduce the environmental impacts associated with traditional waste management practices, while also generating economic benefits for farmers and rural communities. Furthermore, this paper highlights the potential for MATLAB simulations to be used in conjunction with experimental trials to validate model predictions and further optimize agro-waste valorization systems. Overall, the present research work demonstrates the potential