

3rd Global Summit on Climate Changes and Sustainability

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Simulation of Residual Agroforestry Biomass Supply Chains: A Digital Dynamic Mapping

Agroforestry residues represent an important source of biomass with potential to reduce reliance on fossil fuels and lower greenhouse gas emissions. However, large-scale adoption faces major barriers, including logistical inefficiencies, high transport costs, and seasonal fluctuations in supply. These challenges are compounded by the need to align supply chain operations with sustainability goals, such as minimizing CO₂ emissions and embedding green logistics practices. While prior research has explored aspects such as cost or logistics efficiency, there has been limited integration of dynamic simulation methods with sustainability metrics in biomass supply chain analysis.

This study develops a comprehensive framework to enhance the efficiency and sustainability of residual biomass supply chains. It addresses existing gaps by incorporating digital technologies, dynamic simulation, and sustainability indicators into supply chain planning. Using a hybrid approach that combines Geographic Information Systems (GIS) with anyLogistix simulation software, the research focused on Portuguese companies involved in biomass utilization.

Scenario analyses revealed that digital modeling tools can significantly improve biomass logistics. Results showed potential cost reductions of up to 25% and CO₂ emission reductions of 90%, highlighting both economic and environmental benefits. These findings establish the importance of adopting sustainable logistics strategies to reduce costs, mitigate emissions, and improve productivity, while supporting renewable energy goals. The study contributes practical strategies and insights for academia, policymakers, and industry stakeholders, offering a holistic approach distinct from prior studies that often neglected sustainability integration.

Future research will extend this work by combining simulation models with optimization techniques, such as analytical models, machine learning, and multi-objective optimization frameworks. This will enhance adaptability, robustness, and sustainability in biomass supply chains under uncertainty. Additionally, applying the framework across different biomass types and regions could strengthen its universality and global relevance.

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Biography

Dr. Bernardine Chigozie Chidozie is a researcher and engineer passionate about building sustainable energy futures. With a PhD in Industrial Engineering and Management from the University of Aveiro, Portugal, she brings expertise in green logistics, supply chain optimization, and digital technologies for renewable energy systems. As a Research Engineer at Nigeria's National Space Research and Development Agency (NASRDA), she has worked on innovative projects bridging engineering and sustainability. An active contributor to international research, publications, and conferences, she is dedicated to advancing solutions that reduce emissions, optimize resources, and support global clean energy transitions.

