

Forest-Based Bioeconomy Pathways in Indonesia and Malaysia: Resource Potential, Circularity, and Sustainability Challenges

*Charles Lee

University of Newcastle, Australia

charles.cc.lee@newcastle.edu.au

*Corresponding author

Abstract

Forest-based bioeconomy is emerging as a critical pillar for sustainable development in Southeast Asia, particularly in Indonesia and Malaysia, where extensive tropical forest resources underpin both economic growth and environmental services. This paper examines the evolving role of forestry resources in advancing a circular bioeconomy, with emphasis on biomass utilization, value-added products, and integrated agro-forestry systems in these two countries. The study highlights synergies between forestry and agriculture, and their implications for regional biomass supply chains and biorefining industries. Indonesia possesses approximately 94 million hectares of forest cover (about 50% of its land area), while Malaysia maintains around 18 million hectares (~55% forest cover), dominated by dipterocarp forests and peat swamp ecosystems. Over recent decades, both countries have experienced significant land-use changes driven by logging, oil palm expansion, and infrastructure development. Indonesia alone recorded net forest loss exceeding 24 million hectares between 1990 and 2020, although deforestation rates have slowed in recent years due to stronger governance and moratoria policies. Malaysia shows a similar trend of declining deforestation rates, with increasing commitments to sustainable forest management and certification systems such as MTCS and FSC.

A key focus of this study is the diversity of forest biomass resources and their bioeconomic potential. Timber species such as *Shorea* (meranti) and *Dryobalanops* dominate commercial forestry, while lesser-known species like *Melaleuca cajuputi* (locally known as *galam*) in Indonesian peatlands present underutilized opportunities for bioenergy, pulp, and bio-based chemicals. Non-wood forest products (NWFPs), including bamboo, rattan, and resin, further contribute to diversified value chains. In Malaysia, oil palm biomass residues (empty fruit bunches, fronds) are increasingly integrated into circular bioeconomy pathways, complementing traditional wood-based industries. The paper also evaluates technological and logistical innovations supporting biomass valorization, including hybrid feedstock systems, decentralized preprocessing, and emerging biorefinery platforms capable of converting lignocellulosic materials into pulp, biofuels, and advanced biomaterials. These

developments are crucial for reducing reliance on primary timber resources while enhancing circularity through waste-to-resource strategies, consistent with the conference's focus on integrating agro-forestry raw materials into industrial systems. Despite these opportunities, several challenges persist. Deforestation, peatland degradation, and biodiversity loss remain critical concerns, exacerbated by weak enforcement, competing land uses, and global commodity demand. Additionally, supply chain fragmentation, inconsistent biomass quality, and limited infrastructure constrain large-scale bioeconomy deployment. Policy alignment across forestry, agriculture, and industrial sectors remains uneven, hindering integrated resource management.

In conclusion, key strategic pathways are proposed for strengthening the forest-based bioeconomy in Indonesia and Malaysia - including enhanced certification frameworks; investment in biorefinery technologies; and stronger public-private partnerships. By leveraging their rich biomass resources within a circular and sustainable framework, both countries can play a pivotal role in advancing regional and global bioeconomy transitions.