Product Space Model analysis of biomass waste utilization for bioenergy and economic growth in different countries

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Abstract

An enormous amount of waste is generated all over the world every year. According to the World Bank assessments, the amount of waste is 1.3 billion tonnes annually. Therefore, it is important to manage this massive amount of Municipal Solid Waste (MSW) in an eco-friendly manner around the globe. Moya *et al.* (2017). Since the energy crisis of the 1970s, numerous countries are intended to develop biomass as a fuel source. Using biomass for energy generation can significantly overcome the energy crisis and waste management issues.

A study conducted by Qyuum et al. (2021) used the Product Space Model to evaluate feasible feedstocks and technologies for hydrogen production, a clean energy source. The availability of feedstocks was analyzed on a global level. The results showed that Natural gas is the most exportable hydrogen feedstock with a high global export value. In addition, natural gas, coal, electrical energy, and nuts are exportable. This study evaluated exportable feedstocks only for hydrogen production, while the current study assessed the exportable and feasible feedstocks for the different bioenergy forms, including biogas, biodiesel, and bio-oil Qyuum *et al.* (2021).

The proposed research is a novel study based on an entirely new approach to assessing economically viable biomass feedstocks for energy production and export. Different kinds of biomass feedstocks were selected for the proposed study to estimate their potential share in the circular economy. There are total 15 biomass feedstocks and 7 countries selected for this research. The selected biomass feedstocks were assigned HS (Harmonized System) codes from HS6 digit code list issued by UN Comtrade. Only exportable biomass wastes were included in the study. Global export data sourced from OEC was used as input to quantify different PSM indicators. Product Space Model analysis was employed to find feasible biomass wastes for bioenergy production.

The study's findings showed that Canola oil, leather flesh, and poultry waste have higher PRODY values and high-income potential. Therefore, they are suitable for export after meeting local energy demand. While the cashew nut shell, cotton stalk, and animal manure have lower

income potential showed by Product Sophistication analysis. The bio-wastes having low-income potential are more beneficial to utilize in energy generation plants within the country. EXPY analysis revealed that USA made the most sophisticated products, and the minimum level of sophistication was observed for Indonesia. EXPY value indicates the sophistication level of a country's export basket. A country with high EXPY value is considered strong economically and vice versa. Such research must be conducted in other developing biomass-enriched countries to add green energy to their national grids.

This study has practical applications in economic, social, and environmental perspectives as it has focused on economic, clean, and sufficient energy. The study offers a baseline to formulate policies to promote biomass energy generation and biomass export to add benefit to the economy. Furthermore, it identified exportable biomass feedstocks to strengthen a country's economy. To add green energy to their national grids and manage their waste streams eco-friendly, such research must be conducted in other countries with abundant biomass production. In addition, further research must be conducted to evaluate other indicators of the Product Space Model, as they would provide a clearer picture of bioenergy and biomass export prospects.

Keywords: Product Space Model, Biomass waste, Circular economy, Bioenergy

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