

ABSTRACT

The cocoa industry plays a strategic role in Indonesia's economy, but faces serious sustainability challenges due to greenhouse gas emissions, inorganic fertiliser use, and suboptimal waste management. This study aims to design a sustainable green cocoa supply chain by integrating a circular supply chain approach through the utilisation of cocoa shell waste into biochar. The methodology used is Life Cycle Sustainability Assessment (LCSA) which includes three main dimensions: environmental (Life Cycle Assessment), economic (Life Cycle Cost), and social (Social Life Cycle Assessment).

The study results show that the use of biochar can significantly reduce carbon emissions in the Global Warming Potential (GWP) category, namely by 77% in the dry cocoa production process and 84% in waste treatment, compared to the existing system. Economically, the biochar system showed a 5% cost efficiency, 17% increase in annual net profit, and 20% acceleration of Break Even Point (BEP). Socially, the system recorded an average social sustainability score of 3.47, with the highest contribution in socio-economic aspects, but still found shortcomings in occupational health and safety aspects. Meanwhile, the results of the ex-ante S-LCA analysis of the designed biochar system showed an increase in the average social score to 4.13, with significant improvements in the indicators of occupational health, community acceptance, and waste management training.

The study concludes that the integration of LCSA with circular economy principles with biochar utilisation not only improves cocoa supply chain efficiency, but also provides a comprehensive solution in creating a more environmentally friendly, economically viable and socially just production system. The findings are expected to serve as a reference for the development of sustainable policies and practices in the Indonesian cocoa sector.

Keywords: Cocoa, Life Cycle Sustainability Assessment, Biochar, Green Supply Chain, Circular Supply Chain, Sustainability.