

CHAPTER

7

ADVANCED BIOCOMPOSITE FRUIT PICKER POLE: CONCEPTUAL DESIGN

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7.1 ADVANCING SUSTAINABLE DESIGN: NATURAL FIBRE COMPOSITES FOR AGRICULTURAL DEVICES

The contemporary industrial landscape is experiencing heightened global competitiveness, compelling organisations to reassess their approaches to product development and manufacturing (Benabdellah et al., 2020). Companies grapple with increased challenges stemming from intense market competition and ever-expanding customer demands (Salim et al., 2020). Environmental consciousness has become a crucial requirement in contemporary new product design and development (Nurazzi et al., 2022). Integrating environmental considerations and acknowledging life cycle limitations aligned with customer requirements are particularly vital in the early stages of the product design process (Asyraf et al., 2019).

This initial phase allows for greater flexibility in addressing changes and improvements to the product (Safiee et al., 2011). The analysis of material selection, incorporating environmental considerations, aims to substitute traditional materials with more sustainable alternatives

(Nurnadia et al., 2023). By prioritising eco-friendly materials, companies can reduce their carbon footprint and contribute to global sustainability efforts. Additionally, incorporating sustainable practices not only benefits the environment but also enhances the company's reputation and meets the growing consumer demand for greener products.

In the development of a conceptual design for a more sustainable takeout food container (Salwa et al., 2020), this endeavour proposes the utilisation of a natural fibre-reinforced polymer composite (NFRPC). The NFRPC exhibits considerable potential in various product applications, notably in packaging, presenting a viable alternative to petroleum-derived plastic materials (Mohanty et al., 2002). The interest in substituting conventional materials has grown, supported by research experiments demonstrating the effectiveness of NFRPC materials in such applications.

The use of natural fibres not only enhances the mechanical properties of the composites but also aligns with the global shift towards renewable and biodegradable materials. By leveraging agricultural by-products and other renewable sources, the production of NFRPC can contribute to waste reduction and promote a circular economy (Ejiogu et al., 2019). The integration of natural fibre reinforcement also contributes to reducing the production costs of the composite-making process (Fauzi et al., 2023; Islam & Ismail, 2023). Furthermore, products with entirely composite structures, such as natural fibre-based composites, do not persist in biological systems as they return to the environment after the post-use period (Zainudin et al., 2023). NFRPC, owing to its natural status, represents a more environmentally friendly option (Rosli et al., 2022).

The field of fruit picking is witnessing advancements, and concurrent with this, existing agricultural technologies are undergoing evolution, presenting opportunities for novel developments in design and materials, particularly concerning the integration of natural fibres (Azlan et al., 2023). The adoption of natural fibre materials in agricultural tools not only enhances sustainability but also offers

improved mechanical properties, such as increased strength and reduced weight, making the tools easier to handle and more efficient.

Moreover, there is a notable absence of recent innovations in fruit pickers that incorporate cutting-edge technologies like power sources for the primary system and a sustainable pole constructed from natural fibre materials, both within Malaysia and on a global scale. This gap highlights the potential for research and development in creating more efficient, eco-friendly fruit-picking tools that leverage renewable resources and advanced technology. By addressing this need, there is an opportunity to significantly impact the agricultural sector, promoting sustainability and improving productivity.

The contemporary fruit-picking apparatus is relatively uncomplicated, consisting primarily of a handling pole and an attached picking system (Dixit & Ali, 2017). Our primary emphasis is directed towards enhancing the functionality of the central pole, recognising its pivotal role in the overall fruit-picking process. Additionally, the sustainability of the fruit picker pole warrants improvement through the reinforcement of natural fibres, a measure aimed at both cost savings and environmental conservation (Bahrain et al., 2022). To meet the evolving demands of users and adhere to environmentally conscious practices, the design of the fruit picker pole must address several key aspects. This includes improving the strength and durability of the pole through the use of high-quality natural fibres, ensuring that it can withstand the rigours of repeated use in various environmental conditions.

Additionally, the design must ensure the pole's functionality without causing harm to users or the environment, maximise the utilisation of natural fibre materials, facilitate the easy configuration of natural fibre selection, enable consumers to handle the design effortlessly, monitor material reinforcements to uphold performance guarantees, minimise natural fibre waste, and provide manufacturers with the capability to prioritise natural fibre management in the manufacturing process. Successful management of these design expectations is crucial for