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Improving the Impact of Bio-Based Plastic Materials on Baby Products from a Circular Economy Perspective Toward Business Operations: A Case Study at PT. XYZ

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ABSTRACT

Bio-based plastic material is one of the non-fossil materials that gain popularity these days. This kind of material is made from renewable energy that helps to reduce the waste that impacts on the environment. Despite its popularity, this material procurement is also another challenge due to its rare manufacturers or suppliers and impacts the overall procurement cost and time consuming. This case study aims to evaluate and assess the impact of using bio-based plastic material in the manufacturing processes of baby products and its subsequent effect such as: productivity, quality, cost, product sustainability and the market acceptance at PT. XYZ. The research employs a mixed-methods approach, combining qualitative analysis of manufacturing productivity metrics with market trend analysis. Preliminary findings at PT. XYZ found that the use of biobased plastic material can reduce the manufacturing productivity due to its difficulty of processing and cost-effectiveness. This research concludes with a discussion on the implications of these findings and the solutions for manufacturers, marketers, and policymakers in the baby products industry, and suggests directions for future research improvement.

Keywords: Baby Product Industry; Bio-Based Plastic; Circular Economy; Manufacturing; Product Sustainability.

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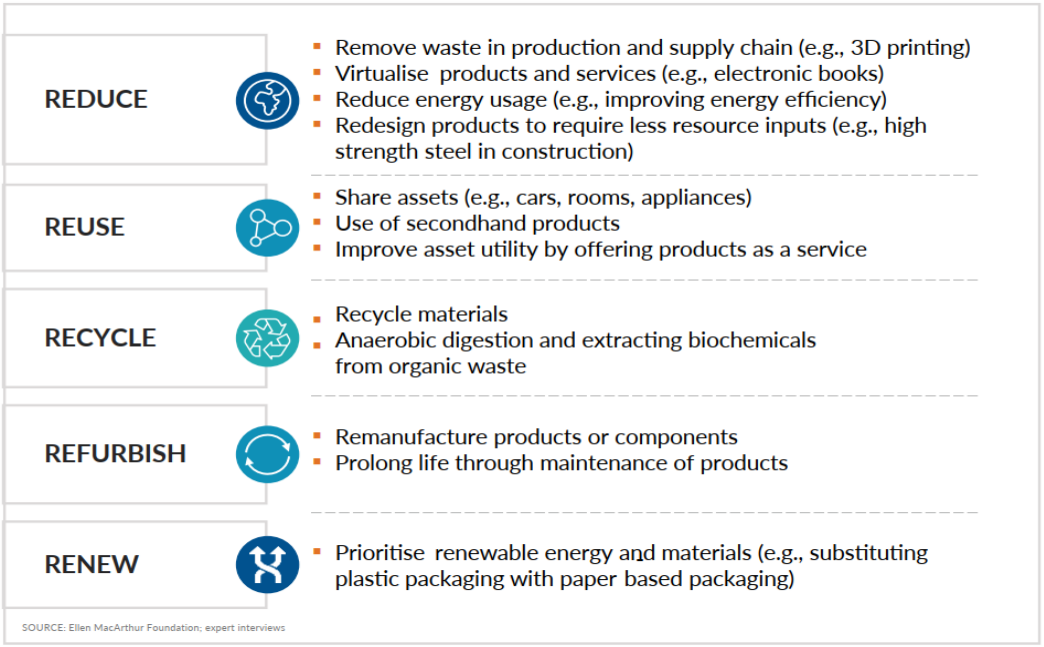
INTRODUCTION

PT. XYZ has been recognized by generations of parents and their babies as a premium baby care products well know company. The company currently manufactures baby products such as bottles, nipples, feeding sets and breastfeeding kits. As a leading manufacturer of baby care products with rich experience in this field, the company emphasizes the great importance of conducting extensive research on product development with the goal is to preserve and promote the values with the circular economy aims to minimizing the social and environmental damage caused by a linear economic approach.

Circular economy involved a wide range across all economic sectors, and the activities focused on the 5Rs: Reduce, Reuse, Recycle, Refurbish, and Renew (Figure 1). Based on the circular potential of the 5Rs for each sector, sector-specific circular opportunities were prioritized. These opportunities were identified based on available data on opportunities that could have the greatest impact in this sector and were revised based on stakeholder consultations (Ellen MacArthur Foundation, 2019).

Figure 1. Circular Approach Comprises The 5Rs



Source: Ellen MacArthur Foundation (2019); Expert Interviews

The alignment of PT. XYZ In the context of implementing the principles of a circular economy for the company strategies in Indonesia could significantly help in minimizing waste creation at the source and encouraging proper recycling of the waste. Through circular approaches like designing for longevity, encouraging reuse, and improving recycling Indonesia plans to reduce waste generation at the source. This new approach to waste management can redefine the waste stream of a significant portion and thus help in the creation of a sustainable and more efficient future.

Figure 2. Circular Economy 2030

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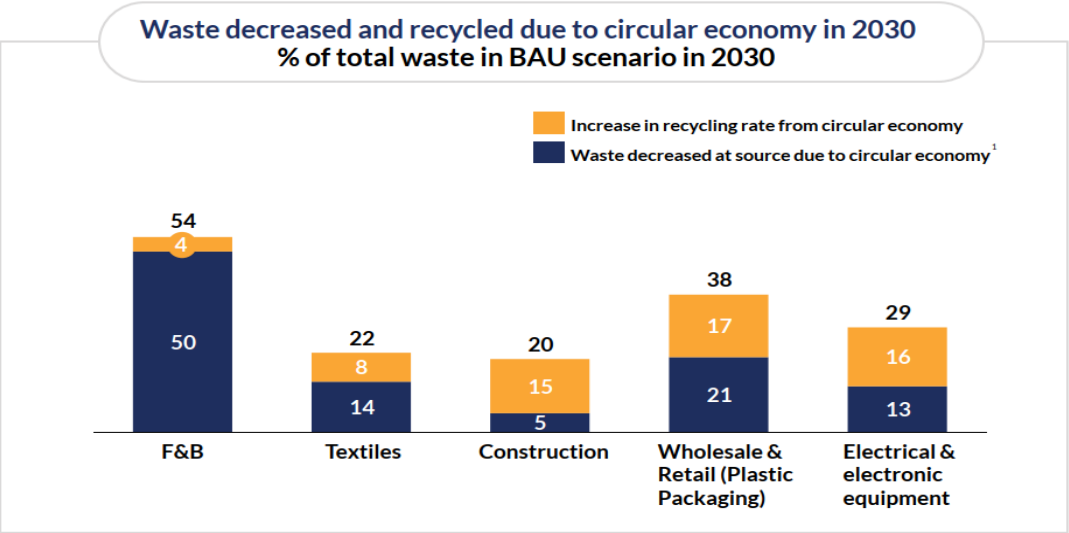

Source: BPS (2024); Bank Indonesia (2024); Ministry of Environment and Forestry (2021); WRI (2024)

This image illustrates the proposed effect of a circular economy approach on waste management and recycling within the various sectors in the year 2030 when compared to a BAU (Business-As-Usual) condition. Focusing on the Wholesale & Retail (Plastic Packaging) sector, Total impact: The circular economy in this sector is expected to cut and recycle 38 percent of the overall waste as contrasted to the BAU situation in 2030. Waste decrease at source: It has been predicted that overall, through circular economy practices the proportion of waste would be reduced by 21 % where 8 % of the amount would be decreased at the source. This probably causes such measures as the minimization of packaging, the employment of better packaging strategies, or the adoption of packaging hoods. Increase in recycling rate: another 17% of waste is expected to be recycled because of execution of circular economy strategies. This implies upgrade of collection systems, technological advances in recycling plastic and probably higher demand for recycled plastic products. Relative impact: Therefore, most environmental impact is covered by the F&B sector with an account of 54% while the Wholesale & Retail (Plastic Packaging) accounts for the second half with a total impact of 38%. It also has the largest rise in recycling rate (17 percent) among all the sectors in the work depicted. Balance of strategies: The level of recycling of plastic packaging waste reached 17%, while 21% of this type of waste was reduced at the source, thus, the work was carried out comprehensively (Ministry of Environment and Forestry, 2021). Based on this data, it can infer that the potential of implementing a circular economy could significantly reduce and facilitate the management of plastic packaging waste in the wholesale and retail sector by 2030 through source reduction and recycling initiatives (WRI, 2024).

LITERATURE REVIEW

Bio-Based Plastic Materials in Manufacturing

Bio-based plastics are derived from renewable biological sources such as corn starch, sugarcane, or cellulose. These materials have gained increasing attention in recent years due to their potential to reduce reliance on fossil fuels and decrease the environmental footprint of plastic production (Chinthapalli et al., 2023). Studies by Jha et al. (2024) show that although bio-based plastics have environmental advantages, challenges persist in terms of material performance, availability, and cost-effectiveness

during large-scale manufacturing processes. The complexity of bio-based plastic processing, including its lower thermal resistance and longer molding time, often results in reduced productivity in industrial applications (Mansur et al., 2020).

Circular Economy Principles and Industrial Adaptation

The circular economy (CE) promotes a shift from a linear "take-make-dispose" production model toward one that is regenerative by design. The principles of CE include reducing resource input, reusing materials, recycling waste, and designing products for durability and repair (Ellen MacArthur Foundation, 2019). In the context of manufacturing, CE requires rethinking supply chains, product designs, and waste management. Industries that implement circular strategies have been found to improve long-term sustainability, reduce operational costs, and enhance brand value (Geissdoerfer et al., 2017). For plastic-related industries, CE particularly focuses on packaging reduction, closed-loop recycling, and bio-based alternatives (Zhang & Xie, 2022).

Sustainability and Consumer Acceptance of Baby Products

Consumers of baby products are increasingly aware of product safety, environmental impact, and ethical sourcing. According to Lee and Hwang (2022), sustainability is a critical factor influencing purchase behavior in the baby care industry. Bio-based plastics can appeal to eco-conscious consumers, especially when products are labeled as BPA-free, biodegradable, or made from renewable resources. However, the premium cost and limited availability of these products may still hinder broader market adoption. Product quality, health benefits, and environmental certifications are essential in influencing consumer trust and loyalty (Kurniawan et al., 2023).

Challenges of Bio-Based Plastics in Industrial Application

Despite the positive environmental attributes, manufacturers face several technical and economic challenges when adopting bio-based plastics (Hikmah et al., 2025). These include supply chain instability, material inconsistency, and lack of standardization in performance testing. According to research by Xiang & Chin (2021), companies need to invest in specialized machinery and staff training, which may not be feasible for small to medium enterprises. Furthermore, without government subsidies or clear policy support, the business case for switching to bio-based plastics remains weak in many developing economies.

Integration of Circular Economy in Indonesian Industrial Policy

Indonesia has committed to integrating circular economy strategies into its national development plans. Key policies such as the National Waste Management Policy (Kebijakan dan Strategi Nasional Pengelolaan Sampah – Jakstranas) emphasize reducing plastic waste and promoting recycling and renewable materials in manufacturing (Ministry of Environment and Forestry, 2021). Sectors such as food & beverage, retail packaging, and consumer goods (including baby products) are among the top contributors to plastic waste, thus prioritized for CE adoption. According to Bank Indonesia and WRI (2024), adopting CE practices across sectors by 2030 could reduce plastic waste by 38%, particularly by minimizing packaging and increasing recycling efficiency.

RESEARCH METHOD

The qualitative approach is used to conduct this study's data collection and analysis. This research is conducted in the form of numbers and provides a fundamental connection between empirical observation and hypothesis qualitative relationship. The

method is using direct interviews to get an actual result. and to get conclusive evidence based on some interview samples and used quantitative research which relies on additional data as sources (journal, the company articles and actual condition).

This research used the sample population of the respondents which are involving biobased plastic material at PT. XYZ. to get a deeper comprehensive result and analysis. Researchers conducted the direct interview and recorded it for several respondents in PT. XYZ.

Table 1. Interview Result

No	Positions	Job Scopes	Years of Experience	Remark
1	MR (Management Representative)	Management Representative	15 years	Interviewee A
2	Head of Purchasing Dept.	Manage Operational for Purchasing (Material Procurement)	6 years	Interviewee B
3	Head of PPIC Dept.	Manage Operational for Production Planning and Inventory Control	5 years	Interviewee C
4	Head of Production Dept.	Manage Operational for Production	10 years	Interviewee D
5	Head of Quality Dept.	Manage Operational for Quality Requirement	6 years	Interviewee E
6	Manager from Material Supplier	Business Relations with customer for material supply and procurement	10 years	Interviewee F
7	Head of Marketing from Sole Agent (Distributor)	Manage Operational for sales and Marketing of Product and Customer Relation	20 years	Interviewee G
8	Head of HR Dept.	Manage of Human Resource of The Company	5 years	Interviewee H

This study employed multiple data collection methods, including literature review, online sources, field observations, and document content analysis. Secondary data were obtained from published written and non-written documents, reflecting the study's descriptive approach. These documents, produced by prior researchers or observers, served as key research instruments.

To complement secondary data, interviews were conducted as a primary instrument to gather relevant insights from company sources. A pre-tested and refined interview guide was used to ensure alignment with the research objectives, thereby enhancing the study's validity. Interviews were conducted with four managerial-level employees, followed by three additional interviews with individuals at the chief level. These steps ensured data sufficiency and supported the attainment of saturation.

RESULTS

The implementation of bio-based plastic materials at PT. XYZ presents both opportunities and operational challenges, requiring a well-structured strategic approach. A comprehensive assessment of the existing production infrastructure is essential to identify necessary adjustments for accommodating these materials. Ensuring product quality is critical, especially in the baby product sector where safety and consistency are non-negotiable. This necessitates robust quality assurance systems and technical modifications.

Employee training is also vital. Staff must be equipped with knowledge of bio-based plastic properties, which differ from conventional materials in terms of handling and processing. This is key to maintaining production efficiency and minimizing errors.

From a resource standpoint, the transition involves substantial capital investment. Machinery upgrades and process modifications may be costly, and the ongoing use of bio-based raw materials, which are generally more expensive than fossil-based alternatives, further increases operational expenses. These financial considerations must be weighed against long-term environmental benefits, such as reducing carbon emissions and supporting circular economy objectives.

Business Situation Analysis

Adopting bio-based plastics in baby product manufacturing brings both internal and external implications. Internally, higher material costs and necessary process changes may hinder efficiency but can also stimulate innovation and improve operations. Externally, while bio-based plastics support sustainability targets and reduce greenhouse gas emissions, they introduce procurement challenges, material inconsistency, and waste management concerns. These factors emphasize the need for integrated strategies that balance environmental goals with practical business operations.

External Analysis

From an external perspective, the transition to bio-based materials introduces several industry-wide dynamics. Using Porter's Five Forces as a framework, key influences were identified:

Threat of New Entrants: The growing emphasis on sustainability may lower barriers for new players, particularly those offering innovative green solutions. However, the capital-intensive nature of bio-based manufacturing still restricts widespread entry.

Supplier Power: The limited number of suppliers in the bio-based plastic industry grants significant bargaining power to producers, potentially raising procurement costs and creating supply risks. This scenario emphasizes the need for strategic supplier partnerships and diversification.

Buyer Power: As bio-based plastics tend to raise product prices, consumers may exhibit greater price sensitivity. Manufacturers must therefore clearly communicate the environmental value and superior quality of their products to justify the higher cost.

Threat of Substitutes: Competitors adopting similar green materials or alternative eco-friendly technologies could reduce the uniqueness of bio-based plastic products. Continuous innovation is crucial to maintain differentiation in the market.

Industry Rivalry: As more firms pursue sustainability, the intensity of competition is expected to increase, particularly in areas such as cost management, material performance, and environmental branding.

These findings illustrate that external forces surrounding the adoption of bio-based plastics are interrelated and complex. While opportunities exist to improve brand value and meet regulatory expectations, companies must also respond to market volatility, supply challenges, and evolving consumer behavior to position themselves successfully in the sustainable manufacturing landscape.

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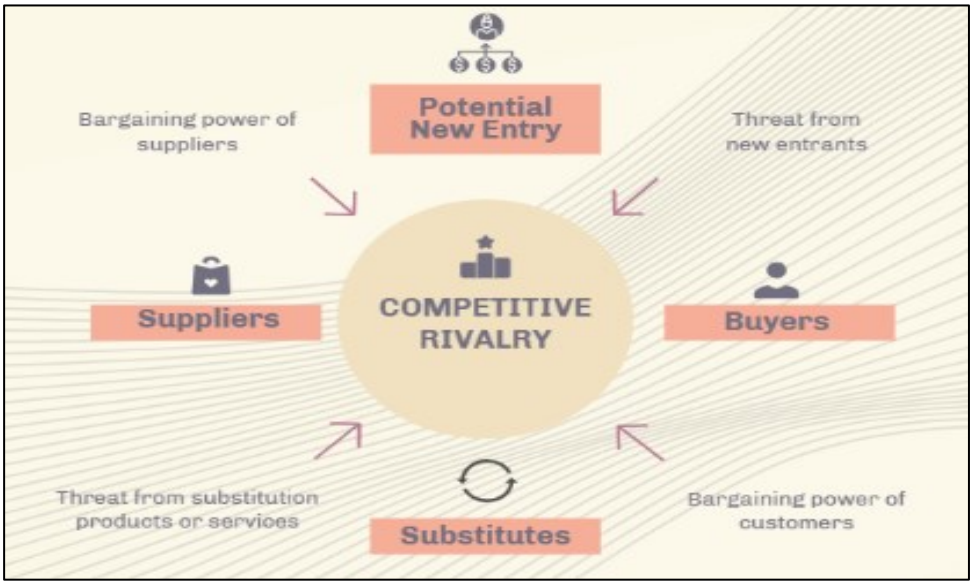
Internal Analysis

Figure 3. Porter's Five Forces



Internally, the integration of bio-based plastics into PT. XYZ's manufacturing operations introduces several operational and strategic challenges. One of the foremost issues is its impact on productivity and efficiency. Due to the different processing characteristics of bio-based materials compared to conventional plastics, adjustments to production lines are necessary. These changes may temporarily reduce output until optimized. In this context, Lean Manufacturing principles become crucial for minimizing waste, improving workflows, and maintaining production performance during the transition.

Cost and quality considerations also present significant constraints. Bio-based plastics are typically more expensive and may exhibit reduced durability or greater sensitivity to temperature. These characteristics can lead to inconsistencies in product quality, which is particularly concerning in baby product manufacturing where safety and reliability are essential. The interdependence of cost, quality, and time must be managed carefully, and the Cost-Quality-Time framework serves as a valuable tool for balancing these factors in decision-making.

Material procurement adds another layer of complexity. As the bio-based plastic industry continues to develop, many suppliers are still building capacity and capabilities. Challenges such as fluctuating availability, unstable pricing, and inconsistent product specifications are common. To mitigate these risks, PT. XYZ must implement strategic supply chain practices, including supplier diversification, long-term collaboration, and proactive risk management.

Financially, the transition poses risks to profitability. Rising costs from materials and equipment adjustments may not be immediately recoverable unless the market supports higher price points. Tools such as break-even and cost-volume-profit analysis are necessary to evaluate financial viability and guide investment decisions in sustainable production.

Finally, market positioning is a key consideration. While demand for sustainable products is increasing, particularly among eco-conscious consumers, premium pricing may reduce competitiveness in cost-sensitive segments. Therefore, marketing strategies

must emphasize product differentiation, environmental benefits, and long-term consumer value. Applying a focused marketing mix can help PT. XYZ connect with target audiences and sustain brand relevance.

In conclusion, the internal shift toward bio-based plastics requires a coordinated approach that integrates production technology, cost management, quality control, and strategic marketing. Success depends on the company's ability to manage these dimensions cohesively while remaining responsive to evolving industry demands.

Conclusion of the Business Analysis

The shift toward bio-based plastics in baby product manufacturing is a strategic decision that demands alignment between internal capabilities and external market forces. Internally, the transition requires equipment adjustments, process adaptation, and acceptance of higher material costs. These costs may be offset by operational efficiencies, government incentives, or premium pricing for sustainable products.

Externally, evolving regulations and growing consumer demand for eco-friendly alternatives offer both pressure and opportunity. Companies adopting bio-based plastics early may benefit from regulatory support and improved brand positioning. However, the transition must be carefully planned, financially viable, and well-executed to manage risks effectively. When implemented strategically, this shift can enhance market competitiveness and align business operations with long-term sustainability goals.

Table 2. Simplified Conceptual Framework

Business Issue	Type of Analysis	Key Aspects Identified
The impact of using bio-based plastic materials on company operations and value proposition	External Analysis (Porter's Five Forces)	• Entry barriers for new competitors • Supplier pricing power • Buyer price sensitivity • Availability of substitutes • Competitive rivalry
	Internal Analysis	• Manufacturing productivity • Cost and material quality • Supplier relationship and procurement • Financial performance • Market positioning and pricing

Supply Chain Situation

The supply chain refers to the interconnected system of people, organizations, resources, and processes that facilitate the movement of a product from raw materials to end consumers (Monjur & Akon, 2023). In the case of bio-based plastics, the supply chain begins with renewable feedstocks such as agricultural crops or waste oil. While traditional fossil-based plastic supply chains are well-established, PT. XYZ's partnerships within the bio-based plastic supply network remain underdeveloped. Suppliers in this emerging sector often face external pressures, including volatile prices and competition for feedstock from other industries, which can disrupt supply consistency.

Pricing Strategies and Supplier Agreements

PT. XYZ's current pricing structure for bio-based polypropylene reflects challenges associated with high production costs. Derived from plant-based feedstock, these

biodegradable plastics often carry a premium price. However, limited technological maturity and the absence of economies of scale prevent cost competitiveness with petroleum-based alternatives. These factors complicate supplier agreements and make long-term pricing stability difficult to achieve.

Research and Development for Bio-Based Plastics

To improve the viability of bio-based plastics, suppliers are actively investing in research and development. Efforts focus on discovering sustainable raw material sources, developing polymers suitable for varied environmental conditions, and advancing processing technologies to increase yields and reduce energy consumption. For instance, polylactic acid (PLA)-based bioplastics demonstrate good elasticity and transparency, making them suitable for packaging (Vrabič-Brodnjak & Jestratijević, 2024). However, their rapid biodegradability limits their mechanical strength, which is essential for PT. XYZ's product lines. Therefore, further innovation is needed to meet the company's quality standards.

Operational Efficiency and Sustainability Alignment

The integration of bio-based plastics into existing manufacturing systems poses significant challenges for PT. XYZ. These include increased costs, adjustments in production operations, and new quality control protocols. Although bio-based plastics contribute to sustainability goals, their compatibility with equipment designed for petroleum-based materials is limited. This incompatibility necessitates additional investments in specialized machinery and processing techniques. Furthermore, achieving operational efficiency while maintaining product quality, brand identity, and environmental responsibility requires a balanced and coordinated approach across the company's supply chain and production strategy.

Biobased Material Cost

Table 3. Biobased Plastic Material Cost

Material Type	MOQ (kg)	Supplier From Overseas				
		Price/kg (USD)	Purchase/kg (IDR)	Import tax and Duty (IDR)	Logistic Cost (IDR)	Final Price (IDR)
Bio-based material	10.500	3.5	**54,698**	137,470,000	22,414,810	**69,925**

Data Processed by Author (2024)

Table 4. Biobased Vs Non-Biobased Plastic Comparison

Year	Quarter	Month	Non Bio	Bio
2022	Q3	July	25.350	-
		Aug	25.857	-
		Sep	25.299	-
	Q4	Oct	22.556	-
		Nov	23.757	-
		Dec	23.431	-
2023	Q1	Jan	21.175	-
		Feb	20.495	-
		Mar	20.628	-
	Q2	Apr	21.497	-
		May	20.606	-
		Jun	20.453	-
	Q3	Jul	20.560	69.925

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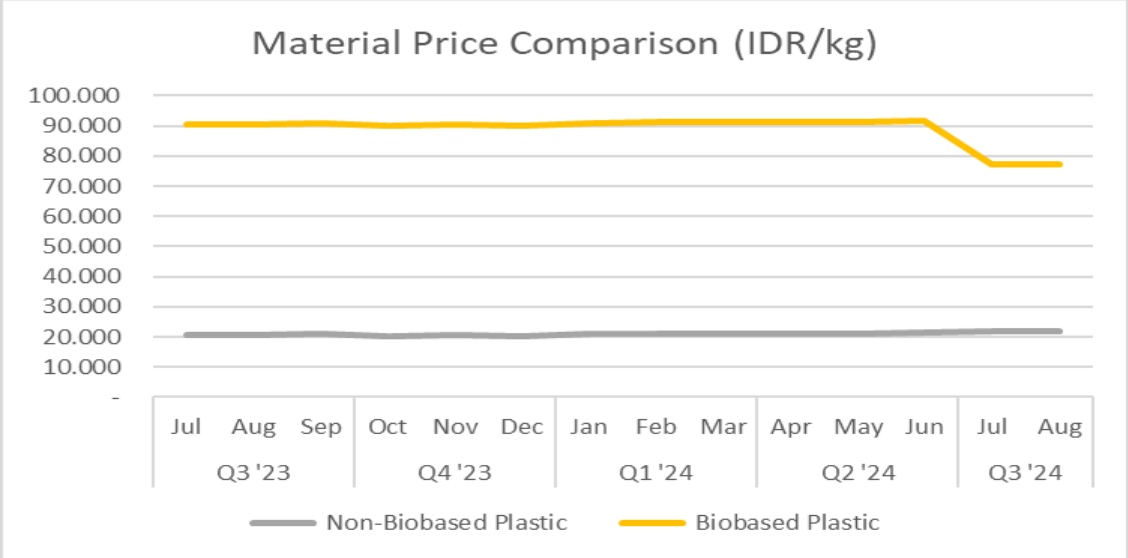
		Aug	20.621	69.925
		Sep	21.087	69.925
	Q4	Oct	20.136	69.925
		Nov	20.341	69.925
		Dec	20.330	69.925
2024	Q1	Jan	21.109	69.925
		Feb	21.176	69.925
		Mar	21.209	69.925
	Q2	Apr	21.209	69.925
		May	21.209	69.925
		Jun	21.643	69.925
	Q3	Jul	21.657	55.598

Figure 4. Biobased Vs Non-Biobased Plastic Comparison



Data Processed by Author (2024)

As can be seen on the table and figure above, the current biobased plastic materials used by PT. XYZ are imported from overseas suppliers and there is additional cost such as import tax and duty + logistic cost. This additional cost impacts the final price of the biobased material (from IDR 54,698 to IDR 69,925). The increment is 27% from the original price. The graph displays two lines representing the price in IDR for non-biobased and biobased PP plastic material. The line for non-biobased PP material remains relatively flat, indicating stable pricing. The price hovers around IDR 20,000 to IDR 30,000. The biobased PP material line shows a significant spike in price. The graph suggests that biobased PP material is significantly more expensive than its non-bio-based counterpart. Organizations considering sustainable materials should be aware of this cost difference.

Table 5. Biobased Plastic Material PSI vs Forecast

Desc	UoM		2023			Forecast 2024										
		Month	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
PP (Biobased Plastic)	Kg	PO month														
		Purchase	10,500													
		Sales to Supplier	775	825	245	170	230	270	340	335	385	495	395	375	470	
		Sales for PT. XYZ	613	373	844.62	0.17	46.27	121.90	146.78	138.98	194.69	229.02	276.96	219.14	212.27	247.33

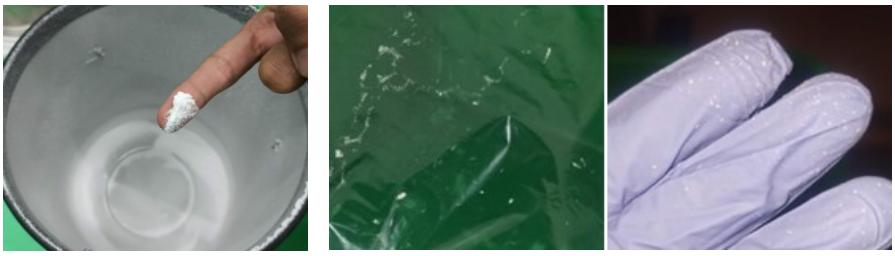
		Inventory Stock	10,500	9,112	8,740	7,070	6,825	6,609	6,257	5,840	5,311	4,781	4,167	3,395	2,781	2,194

Data Processed by Author (2024)

Table 5 presents a planning and forecasting table for biobased plastic spanning from 2023 to 2024. In October 2023, a significant purchase of 10,500 kg biobased plastic material was made, indicating a substantial investment in inventory. The subsequent months show a gradual distribution of sales to suppliers and other entities (PT. XYZ), with varying quantities each month. The forecast for 2024 demonstrates a consistent pattern of sales and distribution, suggesting a stable demand projection. Notably, the ending stock levels fluctuate throughout the period but generally maintain a substantial reserve, implying a strategy to ensure product availability while managing inventory costs. This data provides insights into the company's inventory management approach, sales expectations, and potential market demand for biobased plastic over the analyzed timeframe.

Bio-based Plastic Material Quality Issue

Figure 5. Biobased Plastic Material Quality Trend



Data Processed by Author (2024)

When Biobased material is being developed, there are certain factors which may affect the quality appearance of the material. This white powder is found inside the plastic bag and in the manufacturing process of the product. Material Inconsistency: The white powder and surface roughness indicate problems with material homogeneity and, therefore, the properties of the material are impacted during its injection process.

The manufacturing process involving bio-based plastic materials presents several challenges, particularly in terms of production consistency and product quality. Defects have been observed across multiple stages of the process, including the raw material phase, film formation, and the final product output. These defects indicate that the problems are systemic and not isolated to a single production step, suggesting that the entire process chain requires re-evaluation.

Moreover, the need for intensive quality control has become increasingly evident. Close examination of finished products has revealed various flaws, such as inconsistencies in appearance and surface defects, including those visible on the bottle samples. These observations highlight the critical role of a stringent quality control system to maintain product standards and protect brand reputation.

In terms of marketability, these quality issues significantly impact the visual appeal of the final products. Since baby products, in particular, are often judged by both their functional reliability and visual aesthetics, any deviation in surface finish or clarity could negatively influence consumer perception and purchasing decisions.

These complications are largely attributed to the inherent complexity of bio-based plastic materials. Unlike conventional petroleum-based plastics, bio-based alternatives exhibit

different physical and chemical characteristics, which can lead to unexpected behaviors during processing. This shift introduces new variables that manufacturers must understand and manage carefully. As a result, transitioning to bio-based plastics is not merely a material substitution but requires comprehensive adjustments to formulation, equipment settings, and production protocols to ensure consistent product quality.

DISCUSSION

This study highlights the multifaceted challenges PT. XYZ faces in integrating bio-based plastics into its manufacturing operations. While the transition supports environmental and circular economy goals, it introduces significant operational, financial, and strategic hurdles.

Operationally, the use of bio-based plastics necessitates substantial system adjustments. Interviews with production staff revealed material inconsistencies such as poor thermal resistance and surface defects that hinder product quality. These issues align with Mansur et al. (2020), who reported that incompatibility with existing equipment often reduces manufacturing efficiency. Addressing these challenges will require machinery upgrades, enhanced training, and stricter quality controls.

Financially, PT. XYZ's reliance on imported bio-based materials inflates costs, with a 27 percent increase due to taxes and logistics. This puts pressure on profitability, especially in price-sensitive segments like baby care. As Xiang & Chin (2021) note, bio-based alternatives may remain cost-prohibitive without domestic production or policy support. Strategic cost management and localization efforts are therefore essential.

On the strategic front, sustainability offers potential for brand differentiation, particularly among eco-conscious consumers. However, studies by Kurniawan et al. (2023) and Lee and Hwang (2022) confirm that consumers still prioritize price and performance. If higher costs are not matched by perceived value, market acceptance may decline.

External analysis using Porter's Five Forces underscores supply-side vulnerabilities and intense competition. The limited number of bio-based plastic suppliers increases procurement risk and cost exposure. Moreover, buyer price sensitivity and substitute products intensify market pressure, reinforcing the need for innovation and differentiation, as noted by Geissdoerfer et al. (2017).

Internally, the shift impacts productivity, cost control, and procurement. Lean Manufacturing principles and cost-quality-time frameworks can support operational optimization while advancing sustainability goals (Dams et al., 2023). Supply chain planning also demands attention. While material reserves are maintained, inconsistent production and sales call for better forecasting and coordination. Overreliance on international suppliers further highlights the need for local sourcing to improve resilience (Andiana et al., 2024).

In terms of circular economy alignment, PT. XYZ has reduced its reliance on fossil-based materials but has yet to develop reuse and closed-loop recycling practices. Future initiatives should focus on enhancing material recovery and incorporating recycled content, aligning with national sustainability agendas such as Jakstranas and Circular Economy 2030.

In summary, PT. XYZ's adoption of bio-based plastics presents both opportunity and complexity. Achieving long-term success will depend on overcoming technical and

financial barriers, educating consumers, and strengthening supply chain resilience. With strategic investment and cross-functional coordination, the company can position itself as a leader in sustainable baby product manufacturing.

CONCLUSION

Building on the challenges and strategic insights discussed previously, it becomes clear that PT. XYZ's pursuit of operational efficiency and alignment with circular economy principles is not only a response to current industrial pressures but also a proactive step toward future sustainability. The company addresses these goals through multiple strategies, including adapting manufacturing processes and supply chain systems to accommodate bio-based plastics, fostering long-term supplier relationships, and implementing cost-stabilizing procurement and pricing practices. To ensure product quality, PT. XYZ actively collaborates with bio-based material producers and strengthens quality control protocols. Efforts to localize raw material sourcing also improve inventory management and reduce import dependency. Internally, the company emphasizes resource efficiency, daily operational improvements, and cross-departmental collaboration to enhance productivity. Furthermore, PT. XYZ leverages bio-based plastics as a strategic differentiator to reinforce its environmentally friendly brand image. Through employee engagement and consumer education, the company aims to increase market acceptance and highlight the added value of sustainable products. These integrated efforts position PT. XYZ not only to navigate ongoing business challenges but also to emerge as a leading example of sustainable innovation in the baby product industry. By maintaining a commitment to continuous improvement and strategic foresight, PT. XYZ is well-positioned to serve as a model for other manufacturers seeking to balance environmental responsibility with operational excellence in an increasingly circular global economy.

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DECLARATION OF CONFLICTING INTERESTS

The authors have declared no potential conflicts of interest concerning the study, authorship, and/or publication of this article.

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