

The Role of Environmentally Friendly Practices in the Palm Oil Industry: Encouraging Green Product Production in West Sumatra

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Abstract

Keywords

Environmentally Friendly Practices, Palm Oil Industry, Green Products, West Sumatra

The palm oil industry plays a strategic role in supporting economic growth in Indonesia, particularly in regions such as West Sumatra. However, the rapid expansion of palm oil processing activities has also generated serious environmental challenges, including liquid, solid, and gas waste that may negatively affect ecosystems if not managed properly. Therefore, environmentally friendly practices have become increasingly important to support sustainable industrial development and encourage the production of green products. This study aims to analyze the role of environmentally friendly practices in the palm oil industry in encouraging green product production in West Sumatra. The research employed a qualitative approach by collecting data through interviews, observations, documentation studies, and literature reviews related to sustainable palm oil management. The collected data were analyzed using qualitative descriptive analysis to identify patterns and relationships between environmental practices and green product development. The findings reveal that the implementation of environmentally friendly practices based on Knowledge Management System (KMS) and ecopreneur principles significantly contributes to environmental sustainability and product competitiveness. Effective waste management, the use of environmentally friendly materials, recycling activities, and eco-labeled product development support the creation of sustainable products with higher market value. In conclusion, environmentally friendly practices not only reduce environmental impacts but also strengthen the competitiveness and sustainability of the palm oil industry in West Sumatra.

INTRODUCTION

The largest palm oil-producing country is Indonesia, followed by neighboring Malaysia. Palm oil is one of the plantation commodities that has high value and its industry is classified as labor-intensive and is included in important and strategic commodities because its function is very large in boosting the economy, especially for plantation farmers. With the great benefits of oil palm plantations, several regions in Indonesia are palm oil producers, especially on the islands of Kalimantan and Sumatra (Masitah et al., 2023).

The island of Sumatra, such as West Sumatra, has been planted with oil palm plantations spread across 12 districts and 7 cities. This is supported by the West Sumatra Central Statistics Agency (BPS), In 2018-2022 the Dharmasraya District, Agam District, Lima Puluh Kota District, West Pasaman District, Sijunjung District, and Pesisir Selatan District were the largest palm oil producing areas in West Sumatra. In addition to providing great benefits, the palm oil processing industry also experiences obstacles in controlling its production waste (Abdul-Hamid et al., 2020; Cheah et al., 2023; Maluin et al., 2020). The main product of oil palm plants is crude palm oil commonly known as CPO. The CPO core contributes 25-30 percent and the rest is waste in the form of solid and liquid waste. Palm oil

waste is the remaining palm oil plant products that are not included in the main products or by-products of palm oil processing (Sakai et al., 2022).

Palm oil waste can be categorized into two types, namely palm oil plantation waste and palm oil industry waste (factories). Generally, waste from the palm oil processing industry consists of three types, namely liquid, solid, and gas waste (Kurnia et al., 2016). Liquid waste from the palm oil processing industry comes from the steaming process (sterilization), clarification process, and dirt from hydrocyclones. This liquid waste produces high organic matter so it has the potential to pollute groundwater and water bodies (Chen et al., 2016; Mester et al., 2022; Sharma et al., 2024). Then, solid waste from the palm oil processing industry is categorized into two, namely waste that comes from the processing process in the form of empty bunches, shells or shells, fibers, mud, and cake, and that comes from the liquid waste processing base in the form of active mud carried by the results of wastewater processing. Empty bunches and sludge that cannot be handled can cause a bad smell, become a nesting place for insects and flies, and potentially produce leachate (Supriatna et al., 2022).

The palm oil processing process into oil and coconut kernel oil will produce waste. With a total volume of palm oil waste that is quite high, it can have an impact on environmental damage and disruption of environmental activities (Ayompe et al., 2021; Syahza, 2019). In its production process, the palm oil processing industry produces several residues that are considered waste and have the potential to become a burden of environmental pollution if not managed properly (Kaniapan et al., 2021; Kurnia et al., 2016). If processed optimally using the right technology, these wastes will provide added value that is very important for the palm oil processing industry (Tan et al., 2021).

Other studies also provide relevant insights for the palm oil sector. Sakai et al. (2022) argued that the palm oil industry can support a green economy when waste and by-products are managed through sustainable bioindustry principles. Supriatna et al. (2022) highlighted that composting is one of the effective strategies for more sustainable palm oil waste management, particularly for solid residues such as empty fruit bunches and sludge. Tan et al. (2021) further demonstrated that cleaner production in palm oil mills can be strengthened through advanced treatment of palm oil mill effluent. These findings show that palm oil waste should not only be viewed as an environmental burden but also as a potential resource for producing value-added green products (Ali et al., 2015; Pacheco et al., 2017).

Although previous studies have discussed green innovation, sustainable entrepreneurship, and palm oil waste management, there remains a research gap in explaining how environmentally friendly practices specifically encourage green product production in the palm oil industry of West Sumatra. Many studies focus on national palm oil policy, general sustainability issues, or technological treatment of waste, but fewer studies integrate managerial behavior, Knowledge Management System (KMS), ecopreneur principles, and local industrial practices in one analytical framework (Kamran & Malik, 2025; Mele et al., 2025). This gap is important because the success of green product production does not only depend on technology but also on knowledge transfer, managerial commitment, environmental awareness, and organizational capability (Sahoo et al., 2023; Song et al., 2019; Zhang et al., 2020).

The urgency of this research lies in the need to strengthen the sustainability of the palm oil industry amid increasing global environmental standards and market pressure. Certification

schemes such as Indonesian Sustainable Palm Oil (ISPO) require palm oil actors to comply with environmental, social, and economic sustainability principles. If the palm oil industry fails to adopt environmentally friendly practices, its products may face declining competitiveness in global markets. Conversely, if waste is managed properly and green products are developed consistently, the industry can improve its reputation, reduce environmental risk, and create new economic value. Therefore, this study is urgent for supporting the transformation of palm oil production toward a more sustainable industrial model.

The novelty of this research lies in its focus on the role of environmentally friendly practices in encouraging green product production through the integration of KMS and ecopreneur principles in the West Sumatra palm oil industry. This perspective offers a more comprehensive understanding because it connects environmental knowledge, managerial intention, environmentally friendly behavior, waste management, and green product development. By emphasizing the interaction between people, processes, and technology, this research provides a practical framework for explaining how palm oil companies can transform environmental challenges into sustainable innovation. This novelty distinguishes the study from previous research that mainly focuses on waste treatment technology or general sustainability policy.

This research aims to examine the role of environmentally friendly practices in the palm oil industry in encouraging green product production in West Sumatra. The objective is to analyze how environmental knowledge, managerial behavior, KMS implementation, waste management, and ecopreneur principles contribute to the development of green products. The contribution of this research is both theoretical and practical. Theoretically, it enriches the literature on green product management, sustainable entrepreneurship, and environmental management in agro-industry. Practically, it provides insights for palm oil managers, policymakers, and industry stakeholders in designing sustainable production strategies. The benefit of this research is that it can support the creation of palm oil products that are more competitive, environmentally responsible, and aligned with the principles of sustainable development.

METHOD

This study employed a qualitative research approach to examine the role of environmentally friendly practices in encouraging green product production in the palm oil industry in West Sumatra. The qualitative method was selected because it allows a deeper understanding of environmental management practices, managerial behavior, and sustainability strategies implemented by palm oil companies. The population of this study consisted of palm oil industries operating in several major production areas in West Sumatra, including Dharmasraya, West Pasaman, Agam, and Pesisir Selatan. The research sample was determined purposively by selecting palm oil companies and key informants who have direct involvement in environmentally friendly production activities, such as managers, operational supervisors, environmental officers, and sustainability coordinators. The purposive sampling technique was chosen because it enables the researcher to obtain rich and relevant information from participants who understand the implementation of green practices in the palm oil sector.

The research instrument used in this study consisted of interview guidelines, observation sheets, and documentation reviews. Semi-structured interviews were conducted to explore

participants' experiences, environmental strategies, waste management practices, and green product initiatives. Observations were carried out to identify the implementation of environmentally friendly activities in the production process, including waste treatment systems, recycling practices, and the use of environmentally friendly materials and technologies. Documentation studies were also conducted through the analysis of company reports, sustainability policies, ISPO-related documents, and previous research findings. To ensure the quality of the research instrument, validity testing was conducted using source triangulation and technique triangulation, while reliability was strengthened through consistency checks, repeated observations, and cross-validation of interview results. Data collection techniques included in-depth interviews, direct field observations, and documentation analysis conducted systematically during the research process.

The research procedure began with preliminary observations and literature studies to identify the environmental issues and sustainability practices in the palm oil industry. After obtaining research permits, the researcher conducted interviews, observations, and documentation collection from selected respondents and companies. The collected data were then organized, coded, categorized, and interpreted to identify important themes related to environmentally friendly practices and green product development. Data analysis was carried out using an interactive qualitative analysis model consisting of data reduction, data display, and conclusion drawing. To support the analysis process, qualitative data management software such as NVivo was utilized to classify interview transcripts, identify thematic patterns, and improve analytical accuracy. Through this method, the study aimed to produce comprehensive findings regarding how environmentally friendly practices, environmental knowledge, and sustainable managerial behavior contribute to the development of green products in the palm oil industry of West Sumatra.

RESULT AND DISCUSSION

1. Environmentally Friendly Practices in the Palm Oil Industry

Environmentally friendly practices play a strategic role in improving the sustainability of the palm oil industry in West Sumatra. One of the main efforts implemented to support this is through the implementation of the Knowledge Management System (KMS), a system designed to encourage business management with a more environmentally oriented approach. KMS not only allows companies to share knowledge related to environmentally friendly business processes but also facilitates waste management and offers innovative solutions to overcome various environmental challenges faced in palm oil industry operations. With this system, companies can create a stronger collaborative ecosystem, where sustainable ideas and innovations continue to develop to support the creation of greener industrial practices.

KMS has three main components that are interconnected and play an important role in supporting the successful implementation of environmentally friendly practices, namely people, processes, and technology. The people component includes individuals who have expertise, knowledge, and high commitment to the implementation of environmentally friendly strategies, including managers, technicians, and field workers who are directly involved in operations. Meanwhile, the process is tasked with ensuring that all management and implementation of environmentally friendly practices run systematically and effectively, from planning to evaluating results. On the other hand, technology becomes a supporting pillar that

supports efficiency in knowledge transfer, information storage, and the application of cutting-edge technology that is relevant to the company's needs. With the synergy of these three components, KMS becomes a solid foundation for creating innovation and facilitating the development of environmentally friendly programs as a whole, so that every step taken by the company can contribute significantly to sustainability efforts.

Evaluation of the measurement model through confirmatory factor analysis using the MTMM (MultiTrait-MultiMethod) approach by testing Convergent Validity and Discriminant Validity. Meanwhile, reliability testing is carried out in two ways, namely with Cronbach Alpha and Composite Reliability (Hair et al.,2017). To achieve a valid measurement model in research, there are 3 loading factor calculation processes with a loading factor value ≥ 0.7 which is said to be ideal, meaning that the indicator is valid in measuring the variable it forms and vice versa if the loading factor value is ≤ 0.7 . The first loading factor calculation eliminates 3 indicator items consisting of GEI01, GEB02, and GEB03. This item has a loading factor value below 0.7 and then the model is calculated in the second stage. In the second stage, delete the EK03 indicator and the model is calculated again in the third stage. In this third stage, the model is valid because the construct building indicators already have a value above 0.7 as in Figure 1 above and the table below.

Table 1. Valid Measurement Model

Indicator	Green Product (GP)	Environmentally friendly entrepreneur Intention (EFEI)
GP 01	0,738	
GP 02	0,720	
GP 03	0,820	
EFEI01		0,769
EFEI03		0,740
EFEI05		0,7654

Source: Research Data Processed (2025)

Through the implementation of environmentally friendly practices based on KMS, companies also have the opportunity to utilize environmental potential more optimally. One example is the management of palm oil waste, which can be processed into value-added products such as alternative fuels, biogas, or environmentally friendly organic fertilizers. In addition to reducing negative impacts on the environment, this step also increases operational efficiency, reduces production costs, and opens up opportunities to expand the competitiveness of the palm oil industry in the global market. Thus, the implementation of this practice not only supports environmental sustainability but also makes a significant contribution to the long-term economic growth of the palm oil industry in West Sumatra.

One of the main aspects of this environmentally friendly practice is the effective management of palm oil waste to minimize negative impacts on the environment and create significant added value. Solid, liquid, and gas waste produced from the palm oil processing process has great potential to be utilized for various purposes, such as fuel, animal feed, fertilizer, biogas, and electricity. For example, liquid waste or Palm Oil Mill Effluent (POME) can be processed into biogas which is then used as a source of electrical energy. The use of biogas not only reduces greenhouse gas emissions produced by liquid waste but also helps reduce dependence on fossil fuels, which have been the largest contributors to carbon

emissions. Thus, waste management based on this technology is an effective solution while supporting the sustainability of palm oil industry operations.

In addition to waste management, the use of environmentally friendly materials, machines, and technology in the production process also makes a major contribution to reducing industrial emissions and waste. Many companies in the palm oil industry are now starting to switch to advanced technology that is more energy-efficient and environmentally friendly. Several industry managers, for example, have utilized natural materials and biodegradable packaging in their products, which are more easily decomposed and do not pollute the environment. This step not only reduces pollution and adverse impacts on the ecosystem but also provides a competitive advantage for palm oil products in the global market. Products produced with an environmentally friendly approach tend to be more in demand by consumers who are increasingly concerned about sustainability issues. Thus, the integration of environmentally friendly technology into the production process creates a synergy between economic efficiency and environmental responsibility, which is an important foundation for the future of a sustainable palm oil industry.

Table 2. Path Coefficients, t-statistics, and Significance Levels

Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ((O/STDEV))	P Values	Decision
H1 : Environmentally friendly entrepreneur intentions	0,573	0,785	0,049	10,475	0,000	Accepted
H2: Environmentally friendly entrepreneur behavior -> Green Product	0,532	0,674	0,045	9,512	0,000	Accepted

Source: Research Data Analysis Results (2025)

2. Green Products in the Palm Oil Industry

Green products in the palm oil industry are the result of strong environmental knowledge-based management, which involves various strategic aspects of the company's operations. The role of managers is very crucial in ensuring that each stage of the production process not only meets sustainability standards but also contributes to environmental conservation. Environmental knowledge possessed by management plays a key role in driving the development of environmentally friendly products. This knowledge helps ensure that the products produced are not only safe for consumers but also do not have a negative impact on the ecosystem, thus adding value to the company's reputation in implementing sustainable business practices.

In the palm oil industry in West Sumatra, environmental knowledge transfer is carried out through various mechanisms that involve direct interaction, intensive training, and coordination between teams within the company. This process ensures that every individual in the company has the same understanding of the importance of creating environmentally friendly products. This knowledge transformation is the foundation for the company's success in producing green products that follow consumer needs and preferences while complying with environmental regulations. Management's commitment to environmental protection is

manifested through various steps, including empowering employees to be actively involved in sustainability initiatives, giving awards to teams that succeed in developing innovative solutions, and implementing continuous evaluation and feedback to ensure the sustainability of environmental programs.

With this approach, green products are not only part of corporate social responsibility but also become a strategic tool to create competitive added value in a global market that is increasingly aware of the importance of sustainability. The role of managers as the main drivers in creating a sustainable economic cycle is very necessary to support the sustainability of an environmentally friendly palm oil industry. With competent and environmentally oriented management, green products can be a bridge to increase competitiveness while strengthening the contribution of the palm oil industry in maintaining a balance between economic growth and environmental preservation.

Green products in the palm oil industry are also greatly influenced by the behavior of managers who have an environmentally friendly mindset and perspective, which is the core of the sustainability strategy. This behavior reflects a commitment to ecopreneur principles, such as reduce, reuse, recycle, and upcycle, which are the foundation for more efficient resource management. Managers in the palm oil industry in West Sumatra have demonstrated success in implementing these principles through various innovations that support reducing resource use, optimizing material recycling, and increasing the utility value of products that were previously considered waste. For example, waste materials from palm oil production that are usually thrown away are now used to produce new products with high economic value, in line with the spirit of a circular economy.

By implementing this concept, managers have succeeded in producing environmentally friendly products designed to minimize negative impacts on the environment. The use of safe and non-hazardous raw materials is a priority, complemented by the inclusion of an eco-label that assures consumers that the product is produced following environmental standards. In addition, the packaging used is designed to support sustainability, such as using biodegradable or recyclable materials. This commitment not only helps maintain environmental sustainability but also increases the attractiveness and competitiveness of products in domestic and international markets, especially amidst increasing consumer demand for sustainable products.

This success shows the importance of the role of managers in integrating environmentally friendly behavior into every aspect of the production process. By continuing to minimize negative impacts on the environment and consistently paying attention to the carrying capacity of the ecosystem, companies can ensure long-term production sustainability. In addition, this step allows companies to remain relevant to the demands of the global market that increasingly prioritizes the principle of sustainability. In the long term, the integration of environmentally oriented managerial behavior and the application of ecopreneur principles will create a production system that is not only environmentally friendly but also supports responsible economic growth.

CONCLUSION

The implementation of environmentally friendly practices based on the Knowledge Management System (KMS) and ecopreneur principles in the West Sumatra palm oil industry has shown significant results in supporting environmental sustainability while increasing

product competitiveness in the global market. By integrating people, processes, and technology components, KMS enables companies to manage waste efficiently, create sustainable innovations, and optimally utilize environmental potential. Managers play an important role in ensuring that every stage of production complies with sustainability standards, including through the use of environmentally friendly materials, material recycling, and the development of eco-labeled products and packaging that supports sustainability. This collective commitment not only creates environmentally friendly products but also builds the company's reputation as a socially and environmentally responsible industry player. With this strategy, the palm oil industry not only contributes to economic growth but also becomes a model for maintaining a balance between ecosystem sustainability and operational sustainability.

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