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Palm oil: A choice for balancing economic benefits and environmental sustainability

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Abstract

Palm oil is widely used globally due to its high production efficiency and stable prices, making it a major economic driver for tropical countries. It yields significantly more oil per hectare than other vegetable oil crops, reducing land requirements and potentially lowering deforestation risk if managed sustainably. Despite frequent criticism regarding deforestation and biodiversity loss, recent adoption of sustainability certifications such as RSPO, ISPO, and ISCC has promoted more responsible practices, including zero-deforestation policies, improved waste management, and better worker welfare. Palm oil's nutritional profile, rich in balanced fatty acids and vitamin E (tocotrienols), offers health benefits and oxidative stability, making it suitable for cooking with reduced harmful by-products. Economically, the industry supports millions of jobs and smallholder incomes, particularly in Indonesia and Malaysia. Nevertheless, palm oil faces ongoing challenges in public perception, transparency, and regulatory compliance, necessitating further innovation and education on sustainable practices. Ensuring sustainable growth will require collaboration among governments, producers, and consumers to improve traceability and support certified products, positioning palm oil as a more environmentally friendly and economically viable choice among vegetable oils.

Keywords: Balanced fatty acids, Cooking oil, Eco-friendly, Economical, Healthy choice, Palm oil, Sustainability, Tocotrienols.

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Contribution of this paper to the literature
This article offers a comprehensive analysis of palm oil as both an economic driver and a solution for sustainable vegetable oil production. Its novelty lies in integrating recent empirical findings on sustainability certifications, productivity, and advancements in responsible practices, highlighting palm oil's evolving role in global environmental and economic discussions.

1. Introduction

Palm cooking oil is one of the main resources in the global food and energy industry (Bankole et al., 2024). As the main ingredient in various food products and household needs, palm oil plays an important role in everyday life (Ramasamy, Kadirgama, Mohamed, & Mohd Norsat, 2024). The high production of palm oil makes palm oil the most consumed in developing countries (Abdulkareem & Nasir, 2024). The main advantages of palm oil lie in its stability when heated, its nutritional content, and its more affordable price compared to other vegetable oils, such as soybean, olive, and sunflower oils.

From an economic perspective, palm cooking oil is one of the main sources of income for many tropical countries that rely on the palm oil plantation production sector (Aliyu et al., 2025). Its higher productivity compared to other vegetable oils makes it a more efficient choice to meet global market demand (Maulina et al., 2025). But in the past few decades, the palm oil industry has often been in the spotlight due to unfair environmental controversies, such as forest destruction, loss of animal species, and air pollution (Anifah, Wikandari, Rusimamto, & Widayaka, 2024). These challenges encourage the production of palm oil to strive to improve the sustainability of its production.

In response to these environmental challenges, various initiatives have been undertaken to promote more environmentally friendly production practices. Several certifications, such as RSPO and ISPO, have been developed to ensure that palm oil production is conducted more responsibly (Amalia et al., 2025). These measures include protecting primary forests, managing production waste, and improving the welfare of workers in the plantation sector (Nathan, Senadjki, & Hui Nee, 2025). With the implementation of these sustainability standards, palm oil has the potential to be a more environmentally friendly choice compared to other vegetable oils.

In addition to environmental aspects, palm oil also has advantages in terms of economic efficiency (Lee & Park, 2024). Palm oil production yields more per hectare compared to other vegetable oils. Specifically, one hectare of oil palm land can produce approximately 4 tons of oil annually, whereas crops like soybeans yield only about 0.4 tons per hectare (Sabri, Ginting, & Silalahi, 2025). This efficiency makes palm oil a more economical and profitable choice for producers and consumers.

From a health perspective, palm oil contains a balance between saturated and unsaturated fatty acids and is rich in vitamin E in the form of tocotrienols, which act as natural antioxidants. This oil also has higher oxidative stability compared to other vegetable oils, making it more resistant to repeated heating and less likely to produce harmful compounds when used in frying processes (Malik et al., 2024). Thus, if consumed in reasonable amounts and processed with the correct method, palm oil can be a suitable choice for meeting daily fat requirements.

However, despite its many advantages, palm oil still faces challenges in terms of public perception and regulation. Many environmental organizations and consumers remain skeptical about palm oil production, especially due to concerns about its alleged impact on deforestation and carbon emissions (Aulia et al., 2024). Therefore, studies and innovations are necessary in this industry to enhance transparency, effectiveness, and sustainability in palm oil.

As global awareness of the importance of sustainability increases, some countries have adopted stricter policies on palm oil imports (Bot, Tamba, & Sosso, 2024). For example, the European Union has implemented a policy that limits the use of palm oil in vegetable oil production due to its suspected impact on deforestation (Osman, Min, & Samsuri, 2024). This situation presents both a challenge and an opportunity for the palm oil industry to adapt to global market demands and enhance its credibility through the adoption of more responsible practices.

Increasing innovation in palm oil waste management is also an important factor in supporting the sustainability of this industry (Say, Kong, Nat, Tan, & Tan, 2024). Utilizing waste from palm oil production for biomass energy and organic fertilizer has become a promising solution for reducing the carbon footprint of this industry (Bankole et al., 2024). In addition, recent studies have revealed that various derivatives of palm oil can be used as raw materials in the cosmetics, pharmaceutical, and bioenergy industries, thereby increasing the added value of this industry.

2. Method

This study employs a literature review method, which aims to collect, analyze, and synthesize various academic references related to the advantages of palm cooking oil as an environmentally friendly and economical alternative (Zakaria, Rozali, Mubarak, & Ibrahim, 2024). Literature studies allow researchers to explore various previous studies to gain knowledge of the contribution of palm oil to environmental and economic aspects (Murwani, Kurniati, Ambariyanto, & Sinskey, 2024). In this study, data were collected from reliable sources such as scientific journals, international organization reports, academic books, and publications from government and non-government institutions relevant to the palm oil industry.

The data in this study were obtained from various academic databases, such as Google Scholar, ScienceDirect, Springer, Elsevier, and ResearchGate, which contain indexed scientific journals. In addition, this study also utilized official reports from organizations such as RSPO, FAO, and International Sustainability & Carbon Certification (ISCC), which provide in-depth insights into sustainability practices and the impact of the palm oil industry. Other data sources include reports from the Ministry of Agriculture, the Ministry of Environment and Forestry (KLHK), and the Central Statistics Agency (BPS), which provide information on production, consumption, and policies related to the palm oil industry in Indonesia.

In selecting literature, this study applies several criteria to ensure its relevance to the objectives of the study (Kadir, Motiyus, Azmi, & Jalil, 2024). First, the literature used must have been published in the last 10 years (2014–2024) to ensure that the data studied remains relevant to the latest developments in the palm oil industry. Second, the sources used must come from scientific journals indexed in Scopus, Web of Science, or SINTA, or from trusted institutions with credibility in the fields of economics and the environment (Restiawaty et al., 2024). Third, the selected research must specifically discuss the advantages of palm oil in terms of sustainability and economic efficiency, both on a domestic and global scale (Albuquerque et al., 2024). Fourth, the studies used must present empirical data or case study-based analysis, which provides concrete evidence regarding the impact of palm oil use from various perspectives.

Data collection was carried out in several stages (Kembaren, 2024). First, the researcher identified literature by searching for relevant references using keywords such as "sustainable palm oil," "economic benefits of palm oil," "environmental impact of palm oil," and "environmentally friendly palm oil" in academic databases and institutional reports (Surya & Ismail, 2024). Afterward, the researcher conducted a literature evaluation, where each source was analyzed based on relevance, research methodology, and its contribution to understanding the topic discussed (Wang, Liu, Li, & Xie, 2024). Literature that lacked a strong scientific basis or did not align with the research focus was subsequently excluded from the analysis.

After the evaluation stage, the collected data were analyzed using the content analysis method, which aims to identify patterns, trends, and key findings in the various sources reviewed (Purwanto & Widianto, 2025). The collected data were categorized based on key themes such as environmental impact, economic efficiency, sustainability certification, and comparison with other vegetable oils (Bot et al., 2024). In addition, a qualitative descriptive approach was used to present the data systematically, describe the relationship between palm oil sustainability and its economic impact, and interpret the results of previous studies to build a more comprehensive understanding of this topic.

Through this literature study approach, this research is expected to contribute to understanding the potential of palm oil as a wise choice of vegetable oil that is more environmentally friendly and economical (Suresh et al., 2024). Through analysis of various academic sources and industry reports, this study can identify factors that support production efficiency, environmental impacts that can be minimized, and sustainability strategies that can be applied in the palm oil industry.

3. Results and Discussion

3.1. Results

Based on the literature analysis conducted, this study found that palm cooking oil has various advantages as an environmentally friendly and economical vegetable oil alternative (Mohamad Asrol, Pak Dek, Sumita, & Jusoh, 2024). In terms of production efficiency, palm oil yields significantly more compared to other vegetable oils. According to data from the FAO, palm oil can produce more oil per hectare than other vegetable oil crops, making it a more efficient choice to meet global needs. Wijaya, Setyono, et al., 2024). With high productivity, the land area required to produce palm oil is significantly smaller, which can reduce the potential for deforestation if managed according to sustainability principles.

Palm oil is one of the world's most commonly consumed vegetable oil resources, both in the edible and non-edible sectors (Khuenkaeo & Tippayawong, 2024). Its popularity is supported by several key factors, including high production efficiency, relatively stable prices, and a wide range of uses (Yuniar, Munizu, & Diansari, 2024). However, sustainability issues in palm oil production continue to be a global concern, especially unfairly linked to deforestation and other environmental impacts (Lian, Loo, Tan, & Lye, 2024). Therefore, this study examines the advantages of palm cooking oil from two main perspectives: environmental sustainability and economic benefits.

The results of this study indicate that palm cooking oil has significant advantages in terms of environmental sustainability and economic efficiency compared to other vegetable oils. From an environmental sustainability perspective, palm oil has higher productivity than other vegetable oil sources, such as soybean, sunflower, and canola oils (Guo, Gu, & Meng, 2024). Oil palm trees are capable of producing more oil per hectare than other vegetable oil crops, so the reduced land requirement can help lessen pressure on deforestation or land use change when managed sustainably.

One of the main advantages of palm oil in terms of environmental sustainability is its efficiency in land use (Adeniran et al., 2024). Compared to other vegetable oil crops such as soybeans, sunflowers, and rapeseed, oil palm has a much higher productivity (Hidayati, Nurainy, Suroso, Sartika, & Hadi, 2024). A study revealed that oil palm can produce approximately 4 tons of oil per hectare per year, while soybeans produce only 0.4 tons, sunflowers 0.6 tons, and rapeseed 1 ton per hectare. This efficiency indicates that, to meet global vegetable oil demands, oil palm plantations require significantly less land compared to other alternative crops (Zaukuu, Adam, Nkansah, & Mensah, 2024). Thus, if managed with sustainability principles, palm oil can help reduce the pressure on forest conversion to agricultural land, which is the main cause of deforestation in various tropical regions.

In addition to land efficiency, palm oil also has the potential to reduce greenhouse gas emissions if managed with sustainable agricultural practices (Adeniran et al., 2024). Several studies have shown that oil palm plantations implementing agroforestry practices and peatland restoration can significantly reduce their carbon footprint. Additionally, waste from the palm oil industry, such as empty oil palm bunches (EFB), palm fruit fiber, and palm kernel shells, can be used as a source of sustainable biomass energy (Singh, Chopra, Dhiman, Chuahan, & Garg, 2024). Utilization of this waste reduces dependence on fossil fuels and helps decrease overall carbon emissions. In fact, several palm oil processing plants have adopted methane gas capture and utilization technology to reduce methane emissions from palm oil liquid waste (Zhou, Liu, Fini, Dong, & Cao, 2024). In addition to waste utilization, palm oil is also the primary raw material for biodiesel, a renewable fuel with a lower carbon footprint than fossil-based fuels such as diesel. Several studies have demonstrated that palm oil-based biodiesel can reduce CO_2 emissions by up to 50% compared to conventional diesel.

In recent years, palm oil production has increasingly sought to adopt more environmentally friendly practices (Kadir, Azmi, Addli, Ahmad, & Jalil, 2024). Sustainability standards have been developed to ensure that palm oil production does not damage natural ecosystems (Puspitawati et al., 2025). Some globally recognized standards, such as the RSPO, ensure that palm oil production is carried out without illegal deforestation, land burning, and with attention to the welfare of workers and local communities (Sapawe, Harun, Hassan, Rahim, & Hamzah, 2024). ISPO is a national regulation that governs sustainable palm oil plantation practices in Indonesia (Hidayat, Sholihah, Maulidi, Putri, & Kumoro, 2024). ISCC is a certification that ensures the palm oil used in biodiesel meets sustainability standards. Based on research findings, more palm oil companies are obtaining sustainability certifications, indicating a shift towards more environmentally friendly agricultural practices.

In addition to increasing sustainability in their production processes, several palm oil companies have also invested in forest restoration and conservation programs. Some initiatives include reforestation and rehabilitation of peatlands to reduce the risk of forest fires and greenhouse gas emissions (Li et al., 2024). The establishment of wildlife corridors aims to protect the habitats of threatened species, such as orangutans in Indonesia and Malaysia (Behera & Hotta, 2024). The use of satellite and drone technology to monitor compliance with sustainable agricultural practices. Based on research results, if these practices are implemented consistently, the palm oil industry can contribute positively to biodiversity conservation and the preservation of tropical forest ecosystems.

Although palm oil has many advantages in environmental sustainability, there are still challenges that need to be addressed, including unfounded accusations of deforestation and illegal land expansion. Some small producers are still opening new land in an unsustainable manner, resulting in the loss of natural habitats (Maimanah-Faizah, Ismail-Fitry, Nor-Khaizura, Nor Qhairul Izzreen, & Rozzamri, 2024). Transparency and traceability of the supply chain remain issues, as some palm oil products circulating in the global market cannot yet be fully traced to their origins. Support for smallholders, as independent farmers, often faces difficulties in accessing sustainable agricultural technologies and obtaining sustainability certification.

From an economic perspective, palm oil offers significant advantages in terms of production cost efficiency and more stable prices compared to other vegetable oils (Zhang, Li, & Fan, 2024). Palm oil prices tend to be more competitive due to lower production costs and higher production capacity (Jafar, Juradi, & Bakri, 2024). This efficiency makes palm oil a primary choice in the global food industry, including in the production of margarine, biscuits, chocolate, and other processed foods (Maulina et al., 2025). In addition, palm oil is also used in non-food industries, such as cosmetics, soaps, and detergents, thus increasing its economic value (Fareed, El-Shafay, Gad, & Ağbulut, 2025). Global demand for palm oil continues to increase, especially in developing countries that require a source of vegetable oil with affordable prices and stable availability.

In addition, palm oil production has a significant economic impact on producing countries (Gea, Widati, Syukri, Eddiyanto, & Wardana, 2024). This sector is a source of income for many smallholders who depend on oil palm plantations for their livelihoods (Wijaya, Ramadhani, et al., 2024). Therefore, strengthening policies that support smallholders in increasing productivity and efficiency of land management without expanding plantation areas is an important aspect of maintaining the sustainability of this industry. Support in the form of access to modern agricultural technology, training programs, and stable price policies can help smallholders remain competitive in the international palm oil market.

Globally, palm oil has a large market share and growing demand (Jain, Chandrappa, & Sahoo, 2024). The industry plays a vital role in the economies of palm oil-producing countries, being the world's largest producer. In Indonesia, the palm oil sector contributes significantly to the country's Gross Domestic Product (GDP) and provides a livelihood for millions of smallholder farmers (Ahda, Guntarti, Kusbandari, & Safitri, 2024). With partnership programs between large companies and smallholder farmers, many farmers now have better access to modern agricultural technology, quality fertilizers, and funding that help them increase productivity without having to expand their plantations drastically.

In addition, palm oil is one of the main sources of export revenue for producing countries. Palm oil prices fluctuate in the global market, but in the long term, palm oil prices remain more stable than those of other vegetable oils (Ajeeb, Gomes, Neto, & Baptista, 2025). This makes palm oil a more economical choice for food, cosmetics, and other industries that rely on large supplies of vegetable oils.

On the other hand, this study also identified various economic challenges still faced by palm oil production. The main challenge is the increasingly stringent international trade policies on palm oil, which limit the import of palm oil that does not meet sustainability standards (Zhou et al., 2025). This requires producing countries to further strengthen domestic regulations to ensure that all palm oil production meets international standards in order to remain competitive in the global market.

However, despite its significant economic advantages, the study found that the main challenge in the palm oil industry is the negative image unfairly associated with deforestation and other environmental impacts (Nugrahapsari, Nurmalina, & Fariyanti, 2024). Several studies have unfairly accused the large-scale growth of palm oil farms in the past of causing the loss of tropical forests and threatening biodiversity, especially in areas with high conservation levels such as Sumatra and Kalimantan (Jain & Chandrappa, 2024). Therefore, it is important to continue strengthening sustainability policies that ensure the expansion of the palm oil industry no longer sacrifices natural ecosystems but instead focuses on increasing the productivity of existing land through precision farming methods and technological innovation.

In addition, in terms of nutritional and food safety advantages, studies show that palm oil contains a balance of saturated and unsaturated fats and is rich in vitamin E in the form of tocotrienols, which have high antioxidant properties (Wang et al., 2024). These tocotrienols play a role in maintaining heart health, lowering bad cholesterol (LDL) levels, and protecting body cells from damage caused by oxidative stress. Additionally, palm oil has a high smoke point, making it more stable for cooking methods such as frying compared to other vegetable oils that are more prone to oxidation at high temperatures. This enhances food safety and extends the shelf life of the oil.

Overall, the results of this study indicate that palm oil has great potential as an alternative vegetable oil that is more environmentally friendly and economical if managed sustainably (Ibrahim & Fadzil, 2023). By implementing responsible production practices, utilizing waste as renewable energy, and increasing consumer awareness of the importance of sustainability certification, palm oil can be a solution to meet the world's vegetable oil needs without sacrificing environmental sustainability (Arshad et al., 2024). Therefore, it is important for stakeholders, including government, industry, and consumers, to continue encouraging more sustainable practices to maximize the benefits of palm oil in the future.

3.2. Discussion

Based on the research results, palm cooking oil has many advantages when compared to other plant-based oils, both in terms of production efficiency, environmental impact, price stability, and health benefits (Săpunaru et al., 2024). Among vegetable oils, this one has the highest productivity, more than soybean, sunflower, and rapeseed oils (Putra & Patunru, 2024). In one hectare of land, oil palm is able to produce more oil than other oil crops, making it a more efficient choice to meet global demand (Novita, de Freitas, Fauzia, & Zein, 2024). This efficiency also contributes to the economic aspect, where the price of palm oil tends to be more stable than other vegetable oils, making it the main choice in the food, pharmaceutical, and cosmetic industries.

From an environmental perspective, palm oil is often debated because it is unfairly linked to forest destruction and biodiversity loss (Noah, Othman, Arumugam, Kahar, & Suliman, 2024). However, research shows that implementing sustainable production practices can minimize the impact of the palm oil industry on nature (Osman et al., 2024). Certifications such as RSPO, ISCC, and ISPO are designed to ensure that palm oil production is conducted responsibly, including the implementation of zero deforestation practices and the reduction of carbon emissions. Additionally, more effective management of palm oil waste, such as the utilization of empty fruit bunches and liquid waste as sources of biomass energy, is an important step in minimizing environmental impacts.

In addition, research also shows that palm oil has beneficial nutritional characteristics. This oil contains a balance of saturated and unsaturated fatty acids and is rich in vitamin E in the form of tocotrienols, which are known to have high antioxidant properties (Kim, Baek, & Lee, 2025). This content provides benefits for heart health by helping to lower LDL cholesterol levels and protecting body cells from oxidative stress (Saviola et al., 2024). In addition, palm oil has a high smoke point, which makes it more stable when used for frying than other vegetable oils. This stability reduces the risk of forming harmful compounds due to fat oxidation during the heating process.

In economic terms, palm oil contributes significantly to the economies of producing countries such as Indonesia and Malaysia. This industry creates millions of jobs and serves as a source of income for many small farmers (Gea et al., 2024). Data from the Indonesian Ministry of Agriculture shows that palm oil production is one of the main export sectors that has a positive impact on the national economy. However, to ensure this industry's sustainability, it is necessary to increase transparency in the supply chain, strengthen environmental regulations, and raise consumer awareness in choosing products that have been certified as sustainable.

Despite its many advantages, palm oil also faces several challenges that need to be addressed. One of these is the negative stigma associated with the industry due to irresponsible production practices and accusations in the past (Endo et al., 2024). Therefore, increasing awareness and education about the benefits and potential of sustainably managed palm oil is important (Nursal et al., 2024). The government, industry players, and consumers need to collaborate in encouraging more environmentally friendly production practices, including supporting the use of more efficient and innovative agricultural technologies in land management.

Considering all these aspects, it can be concluded that palm oil has great potential as an environmentally friendly and economical vegetable oil alternative if managed with the principle of sustainability. With the implementation of stricter regulations, the use of more sophisticated agricultural technology, and increasing consumer awareness of the value of sustainability certification, palm oil production has the potential to become a more sustainable solution for global vegetable oil needs in the future without compromising the balance of the ecosystem.

4. Conclusion

Based on the latest literature analysis, palm cooking oil stands out as a more environmentally friendly and economical alternative to vegetable oil. With a higher productivity rate compared to other vegetable oils, palm oil is a more efficient choice in terms of land and resource use. With one hectare of land, oil palm plants are able to produce more oil than other oil-producing crops, such as soybeans, sunflowers, and rapeseed. This advantage makes it a more economical solution in meeting global vegetable oil needs, especially in the food and industrial sectors. In addition, palm oil has high oxidative stability, a better smoke point, and nutritional content that is beneficial to health, such as vitamin E in the form of tocotrienols, which have high antioxidant properties. These benefits make it a safer and more efficient choice for various culinary applications, especially in frying processes that require oil with good heat resistance.

From an environmental perspective, palm oil is often linked to deforestation and biodiversity loss. However, with the increasing adoption of sustainable production practices through certifications such as the Roundtable on Sustainable Palm Oil (RSPO), Indonesia Sustainable Palm Oil (ISPO), and International Sustainability & Carbon Certification (ISCC), negative environmental impacts can be significantly mitigated. Sustainably managed palm oil production can help reduce carbon emissions, preserve ecosystem balance, and utilize production waste as biomass energy and organic fertilizer. These measures demonstrate that the palm oil industry can offer broader benefits when managed according to sustainability principles and responsible practices.

Palm oil has economic advantages that make it a leading commodity in the global market. Its more affordable price compared to other vegetable oils makes it commonly found in various sectors, industries that produce food and other products. In addition, the palm oil industry plays an important role in the economies of producing countries, including Indonesia and Malaysia, not only as a source of foreign exchange but also as a provider of employment for millions of people. Many small farmers depend on this sector for their livelihoods, making it a vital pillar of the economy. With more transparent and sustainable governance, the palm oil industry can continue to provide significant economic benefits without neglecting social and environmental aspects.

Despite its many advantages, palm oil still faces challenges that need to be overcome, especially in changing the negative perception that still exists due to unfair accusations of environmentally unfriendly production practices in the past. Therefore, education and socialization efforts regarding the importance of choosing certified and responsibly managed palm oil products need to be increased. The government, industry sector, and consumers have a crucial role in ensuring that the oil from palm trees is produced through an eco-friendly production process. In addition, research and innovation in waste management and production efficiency also need to be continuously developed to optimize the overall benefits of palm oil.

Overall, palm oil has great potential as an environmentally friendly and economical alternative to vegetable oil. By implementing sustainability principles in the production process, improving environmental regulations, and increasing consumer awareness of certified products, the palm oil sector can further develop as a better solution to meet global vegetable oil needs. The sustainability of this industry depends on cooperation between the government, industry players, and the community in ensuring that palm oil production not only provides economic benefits but also contributes to environmental balance and long-term social welfare.

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