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Article

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Two Decades of Palm Oil Business - Environmental Quality Nexus: A Bibliometric Approach

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ABSTRACT

This study strives in mapping of literature on the link between the palm oil business and environmental quality. It selects a large amount of literature published in the Scopus Database from 2000 to 2022. The literature was analyzed using a Bibliometric approach. The keywords “palm oil and business” resulted in 672 documents, while “palm oil and environmental quality” resulted in 1.378 documents. The finding expresses that most scholars pay more attention to reveal the relationship between palm oil business and sustainable environment. Consequently, the number of documents (literature) increased over time. Journal of Cleaner Production has the highest contribution in the literature on palm oil and environment. Indonesia and Malaysia contribute significantly to qualifying palm oil’s sustainable business and environmental quality. A key implication of the findings is that governments and palm oil businesses should ensure palm oil and environmental sustainability in the long-run.

Keywords: Palm Oil, Environmental, Bibliometric Approach

JEL Classifications: D20, L11, Q15

1. INTRODUCTION

The palm oil business is growing significantly in the Southeast Asian region, especially in Indonesia and Malaysia. In academic circles and among policymakers, the palm oil industry opens a space for debate on several issues, including deforestation (environmental impact and quality), production processes and meeting global market needs, business sustainability strategies, and alternative energy sources. Scholars have published various pieces of literature discussing the palm oil business. Therefore, investigating and mapping the literature on the palm oil business and environmental quality can contribute significantly to the sustainability of both areas.

Carlson et al. (2012) mentioned that the relatively rapid development of the palm oil business delivers opportunities for increasing deforestation and reducing environmental quality.

The largest palm oil producers, such as Indonesia and Malaysia, are developing countries that experience this impact directly. Therefore, Indonesia has committed to implementing sustainable business practices in palm oil firms, known as the Indonesian Sustainable Palm Oil (ISPO) certificate (Carlson et al., 2018). The accelerated development of the palm oil business, especially in Indonesia, continues to consider and care about environmental quality. Azhar et al. (2023) emphasized that palm oil business certification encourages the achievement of sustainability and the certainty of environmental quality. Certification is also expected to reduce the level of deforestation carried out by large-scale industrial palm oil production. The consumers also have concerns about the environmental impact of consuming palm oil products (Ostfeld et al., 2019). The condition means that they are not only buying palm oil products but also sending a message to the palm oil business to participate actively and concretely to ensure environmental quality.

In particular, Hospes et al. (2017) termed the debate on the relatively rapid development of the palm oil business as a black-and-white perspective. This perspective highlights the added value and impact of the palm oil business within the sustainable business framework, starting from the production process to the consequences of production results on the environment. Empirically, the scenario of sustainable part-way formulation of palm oil production in Indonesia has been developed and measured by Afriyanti, et al (2016). They revealed several significant scenarios of palm oil business in Indonesia, namely: (a) the development of palm oil production continues to increase in regards to the level of consumption and energy demand, land availability, production capacity, and environmental quality, and (b) in the future, Indonesia will become a country that contributes significantly to meeting consumption and energy needs from palm oil production. Furthermore, Li et al. (2020) found a pattern of palm oil business development in Malaysia, namely (a) over the past two decades, the palm plantation area has increased significantly, (b) the expansion of palm plantation area is more significant in the eastern region of Malaysia than in the western region, and (c) the price of crude palm oil and the level of deforestation contribute significantly to the process of expanding palm plantation area.

This study seeks to map and uncover literature documents on the relationship between the palm oil business and environmental quality using a bibliometric approach from 2000 to 2022. Moreover, this study contributes to the literature in several ways. Firstly, this study uses two groups of keywords to uncover the link between the palm oil business and environmental quality through better literature mapping. Secondly, this study uses a bibliometric approach that can review a relatively large-scale map of literature documents. Thirdly, policymakers can utilize this study's findings to ensure sustainable environmental quality in the palm oil business. Furthermore, the findings of this study can also be utilized by future researchers to examine the link and impact of the palm oil business on sustainable environmental quality.

The palm oil business is also growing as a provider of alternative energy sources and a reducer of global carbon emission levels (Jumaat et al., 2015). This condition demands palm oil businesses to work harder and actively ensure environmental sustainability and the availability of renewable energy sources. Umar et al. (2018) pointed out that palm oil businesses in Malaysia play an essential role in supporting alternative (new) energy source policies. Therefore, they sent a message to policymakers and palm oil businesses to harmonize and synchronize the upstream-downstream industry. However, Kristanti et al. (2021) signaled that the palm oil business process will generate waste, especially water pollution, which can damage the environment. The zero liquid discharge method can be applied to reduce the negative environmental impact of palm oil business waste.

The main findings reveal that the keywords "palm oil" and "environmental quality" received significant attention from scholars in literature documents published in the Scopus database from 2000 to 2022. Two international journals/proceedings have significantly contributed to disseminating articles regarding the

link between the palm oil business and environmental quality, namely: The IOP Conference Series Earth and Environmental Science and the Journal of Cleaner Production. Besides, Indonesia and Malaysia are the countries that are widely studied in literature documents on the link between the palm oil business and environmental quality.

This study is organized into several sections. The first is an introduction that discusses the relationship between the palm oil business and environmental quality in the literature. The second is the literature review that describes the empirical gaps regarding the relationship between the palm oil business and environmental quality. The third is a methodology that explains the literature documents published by the Scopus database and the bibliometric approach during the observation period. The fourth is results that reveal the map of literature documents on the relationship between the palm oil business and environmental quality during 2000-2022. The last is the summary.

Sundaraja et al. (2020) argued that palm oil business delivers academic and policy debates include deforestation issues, palm oil global market competitiveness, and climate change. Therefore, they suggest that policymakers and palm oil businesses conduct pro-environmental behaviour (PEB) to suppress the negative environmental impact. Besides, Hosseini and Abdul Wahid (2013) noted the significant contribution of wet extraction palm oil mills (POMs) and wet scrubber vessels to cut the level of pollution and environmental breakdown from palm oil production.

In particular, Syahza (2019) investigated the impact of palm oil downstream industries on environmental quality in Indonesia. The study reveals that palm oil business was growing significantly due to geographical condition, high demand of palm oil products and a better profit of palm oil business. However, the farmers/small businesses of palm oil face some challenges such as the quality of input, business knowledge, and business roadmap of sustainable palm oil. Therefore, the Roundtable on Sustainable Palm Oil (RSPO) has been employed to the global palm oil production. Lee et al. (2020) found that, in the short-run, RSPO contributes significantly on environmental conservation in Kalimantan and Sumatra during 2003-2014. The condition sends a positive message to policymakers and palm oil business to guarantee the sustainable palm oil business and to improve environmental quality in Indonesia.

Moreover, Meijaard et al. (2020) emphasize on the significant contribution of Sustainable Development Goals (SDGs) in balancing the palm oil business and environmental quality. The condition means that the expansion of palm oil business need considering sustainable economic, environment and social under SDGs framework. Purnomo et al. (2020) noted that palm oil business provides economic advantages for Indonesia and Malaysia. The palm oil business has been developed and managed by private corporations, state-owned companies and smallholders to supply of 85% of global palm oil products. They suggested that the governments and palm oil businesses should propose and conduct a synergy between palm oil business and forest conservation.

2. METHODOLOGY

2.1. The Data

This study maps the literature on the palm oil business-environmental quality nexus. Literature was collected from various journals sourced from the Scopus Database. The literature was analysed using the Bibliometric approach through Vosviewer version 1.6.17. Figure 1 describes the procedure for determining the sample of literature documents using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). It is divided into two figures: Figure 1a uses two keywords (palm oil and business), and Figure 1b also sets two keywords (palm oil and environmental quality).

A literature search using the keywords “palm oil” and “business” found 701 documents from 2000 to 2022. These documents were sorted using a bibliometric approach, which resulted in 672 eligible documents. Meanwhile, a search using the keywords “palm oil” and “environmental quality” resulted in 2420 documents. These documents were narrowed down to 1378 eligible documents. These findings revealed that the keyword pairs in Figure 1b received more attention and academic review by scholars. Indirectly, scholars emphasize that the existence and development of the palm oil business are significantly related to environmental quality.

The literature documents selected in the Bibliometric approach include Articles, Conference Papers, Reviews, Book Chapters, Notes, Conference Reviews, Books, Short Surveys, Reports, and Editorials. Literature sources include journals, Conference Proceedings, Book Series, Books, and Trade Journals. Meanwhile, some languages used in literature documents include English, Japanese, Portuguese, Spanish, Malay, Indonesian, and French.

2.2. Bibliometric Approach

Academic scholars largely notice a literature survey in the recent decade. One of the mappings of a literature survey was the

bibliometric approach. The bibliometric approach can be set to reveal international scientific mobility on knowledge transfer on a large scale (Aman, 2018). It evaluates knowledge development on a specific subject and measures the scientific impact of research and sources by considering bibliographic data (Bouyssou and Marchant, 2011; Zupic and Čater, 2015; Feng et al., 2017). Besides, the bibliometric approach assesses the impact and visibility of different objects of study, and it is an effective way of detecting new fronts of research (De Filippo et al., 2021; Vinkler, 1988; Callon et al., 1995).

The bibliometric provided provides network analyses with a clear point of the various links between scientific studies, countries, authors, and keywords (Desalegn and Tangl, 2022; De Bakker et al., 2005; Kumar et al., 2020). It will show the findings of scientific activity at the macro level (countries, regions), meso level (journals), and micro level (research groups or individual authors).

3. RESULTS AND DISCUSSION

3.1. Time Analysis

The time analysis describes the movement of the number of literature documents using the keywords “palm oil” and “business” over the period 2000-2022, as shown in Figure 2a. This figure illustrates that, during the observation period, the movement of the number of documents fluctuated. During the first 7 years of observation, the number of publications was still below 10 documents. However, since 2007, the number of literature documents began to increase above 10 documents. The highest number of literature occurred in 2021, which was 77 documents. In contrast, in 2015, there was a significant decrease in the number of documents, namely 17 documents, compared to the previous year's 68 documents.

Furthermore, the time analysis also describes the movement of the literature document number using the keywords “palm oil” and

Figure 1: PRISMA flow chart sample. (a) “palm oil” and “business.” (b) “palm oil” and “environmental quality”

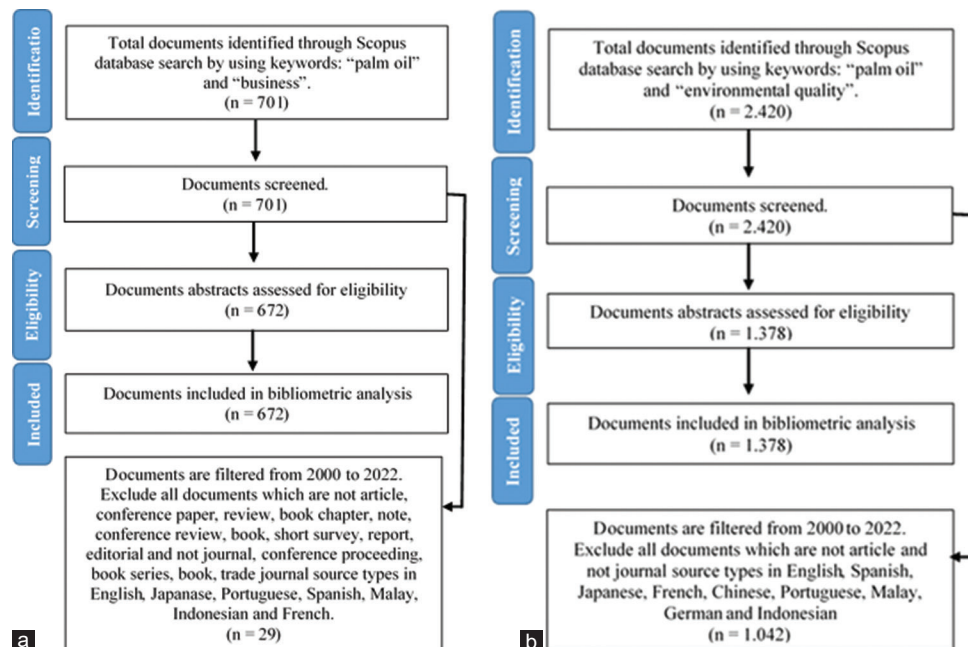
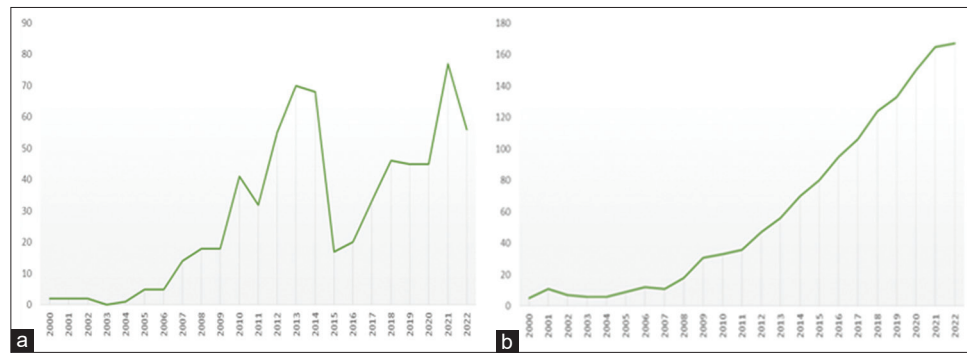


Figure 2: Number of selected research documents during 2000-2022. (a) “palm oil” and “business.” (b) “palm oil” and “environmental quality”

“environmental quality,” as shown in Figure 2b. The movement of the number of documents increased from year to year. This condition means that studies that reveal the relationship between palm oil and environmental quality tend to be of interest to scholars and contribute significantly to the existence of literature.

Figure 2b also shows that the number of literature documents decreased slightly in 2002 and 2007. The highest number of literature documents occurred in 2022, namely 167 documents. In contrast, the lowest number of literature documents occurred in 2000, which was only 5 documents. An exciting finding is shown by the number of literature documents in 2020, which is 150. This number is higher than the previous year’s documents of 133. This condition is related to the impact of the COVID-19 pandemic. The COVID-19 pandemic posed new challenges in the health sector that impacted scientific publication activities, with a peak in the number of publications in May and June 2020 (Strobl and Roth, 2021).

3.2. Journal Analysis

The journal analysis outlined several journals that contributed significantly to the literature documents using the keywords "palm oil" and "business" (Table 1a). Table 1a reveals that over 100 journals published literature documents. In particular, eight journals contributed significantly, including: (1) IOP Conference Series Earth and Environmental Science (52 documents), (2) Applied Biochemistry and Biotechnology (19 documents), (3) IOP Conference Series Materials Science and Engineering (16 documents), (4) E3S Web of Conferences (12 documents), (5) Green Energy and Technology (10 documents), (6) World Journal of Microbiology and Biotechnology (10 documents), (7) Biodiversity and Conservation (10 documents), and (8) Mitigation and Adaptation Strategies for Global Change (10 documents).

Other keywords used were “palm oil” and “environmental quality.” The search for these two keywords yielded more than 130 journals (Table 1b). A detailed description of the contribution of these journals highlights 6 journals with significant contributions to the literature. These journals are (1) Journal of Cleaner Production (39 documents), (2) Journal of Oil Palm Research (35 documents), (3) Construction and Building Materials (22 documents), (4) Sustainability Switzerland (17 documents), (5) Chemical Engineering Transactions (13 documents), and (6) Journal of Environmental Management (13 documents).

3.3. Authorship Analysis

The authorship analysis emphasized authors who contributed significantly to literature documents with the keywords “palm oil” and “business.” The analysis found 13 authors that were divided into 2 clusters. Cluster 1 features Hospes as the author with the most significant contribution to the literature with 4 documents. One of the articles that Hospes published was titled *New Generation of Knowledge: Towards an Inter-and Transdisciplinary Framework for Sustainable Pathways of Palm Oil Production* (Hospes et al., 2017). Meanwhile, cluster 2 has Koh as the author with the most significant contribution with 5 literature documents. One of the articles that Koh published was titled *Remotely Sensed Evidence of Tropical Peatland Conversion to Oil Palm* (Koh et al., 2011).

Furthermore, authorship analysis was also applied to the keywords “palm oil” and “environmental quality.” The analysis revealed that 327 authors contributed significantly to the literature documents, divided into 27 clusters. In particular, some authors who have contributed significantly, which include: (1) Jumaat (cluster 7) who has published 10 documents with one of his articles entitled *Characteristics of Palm Oil Clinker as Replacement for Oil Palm Shell in Lightweight Concrete Subjected to Elevated Temperature* (Jumaat et al., 2015); (2) Muthusamy (cluster 23) who has published 9 articles with one of his publications entitled *Properties of High Strength Palm Oil Clinker Lightweight Concrete Containing Palm Oil Fuel Ash in Tropical Climate* (Muthusamy et al., 2019); (3) Azhar (cluster 8) who has published 8 articles with one of his publications entitled *Large-Scale Industrial Plantations are more likely than Smallholdings to Threaten Biodiversity from Oil Palm Replanting Spatial Disturbances* (Azhar et al., 2023); (4) Shafigh (cluster 7) who has published 8 articles with one of his publications entitled *Shear Behaviour of Lightweight Aggregate Concrete Beams Using Palm-Oil by-Products as Coarse Aggregate* (Shafigh et al., 2021).

3.4. Keywords Analysis

The keyword analysis was used to identify all keywords that discuss the palm oil business from 2000 to 2022. The findings explain 704 keywords grouped into 9 clusters, each colour representing its own cluster (Figure 3a). There are 10 keywords with the highest frequency, namely: (1) Palm Oil (284 occurrences); (2) Elaeis (153 occurrences); (3) Oil Palm (91 occurrences); (4) Indonesia (80 occurrences); (5) Sustainable Development (75 occurrences); (6) Article/Research (71 occurrences); (7) Sustainability (56 occurrences); (8) Agriculture (51 occurrences); (9) Biomass (47 occurrences); and (10) Vegetable Oils (46 occurrences).

Table 1: Number of Selected Journals

A “palm oil” and “business”	
Journal	Number of Papers
IOP Conference Series Earth and Environmental Science	52
Applied Biochemistry and Biotechnology	19
IOP Conference Series Materials Science and Engineering	16
E3S Web of Conferences	12
Green Energy and Technology; World Journal of Microbiology and Biotechnology; Biodiversity and Conservation; and Mitigation and Adaptation Strategies for Global Change	10
Journal of Cleaner Production; and Water Air and Soil Pollution	8
Sustainability Switzerland; and Chemical Engineering Transactions	7
Food and Bioprocess Technology; Journal of Polymers and The Environment; Land Use Policy; Fuels and Lubes International; Agriculture and Human Values; Research on Chemical Intermediates; Agroforestry Systems; and Environment Development and Sustainability	6
International Journal of Sustainable Development and Planning; Cellulose; Fish Physiology and Biochemistry; Journal of Materials Science; Molecular Biology Reports; and Plant and Soil	5
b. “palm oil” and “environmental quality”	
Journal of Cleaner Production	39
Journal of Oil Palm Research	35
Construction and Building Materials	22
Sustainability Switzerland	17
Chemical Engineering Transactions; and Journal of Environmental Management	13
Sains Malaysiana	10
Jurnal Teknologi; Journal of Advanced Research in Fluid Mechanics and Thermal Sciences; Plos One; Land Use Policy; and Malaysian Journal of Analytical Sciences	9
Desalination and Water Treatment; International Journal of Remote Sensing; Industrial Crops and Products; Environmental Research Letters; and Bioresource Technology	8
Environmental Science and Pollution Research; Energy Conversion and Management; Scientific Reports; and ARPN Journal of Engineering and Applied Sciences	7
Biodiversity and Conservation; Energy; Biological Conservation; Environmental Monitoring and Assessment; Biomass and Bioenergy; Forest Policy and Economics; Agriculture Ecosystems and Environment; Journal of Engineering Science and Technology; Science of The Total Environment; Materials; Biomass Conversion and Biorefinery; and Chemosphere	6
Bioresources; Environmental Technology and Innovation; Polymers; International Journal of Applied Engineering Research; Waste and Biomass Valorization; Journal of Sustainability Science and Management; Applied Energy; Journal of Tropical Forest Science; OCL Oilseeds and Fats Crops and Lipids; Advances in Environmental Biology; Journal of Building Engineering; Malaysian Journal of Microbiology; and International Journal of Environmental Science and Technology	5

Keywords “Elaeis,” “Oil Palm,” “Indonesia,” and “Sustainability” come from Cluster 1. This palm oil business can supply 86% of the world’s palm oil supply. Many companies have made commitments to purchase or produce “sustainable” palm oil. Sustainability certification is the most widely applied policy instrument; 20% of global palm oil production is certified by the Roundtable on Sustainable Palm Oil (RSPO) (Wong et al., 2021; Wong et al., 2022; and Carlson et al., 2018).

The keywords “Article” and “Vegetable Oils” are from Cluster 2. Vegetable oils have been discussed in the literature for the last 15 years. Vegetable oils are considered alternative materials that can effectively and economically help achieve green machining (Martin et al., 2013; Azmi and Jalil, 2017; Sankaranarayanan et al., 2021).

The keywords “Palm Oil,” “Sustainable Development,” “Agriculture,” and “Biomass” come from Cluster 3. Palm biomass waste is a sustainable source of energy industry as a source of electricity. The concept offers great potential for large-scale power generation in Malaysia. About 85.5% of the biomass in Malaysia comes from oil palm farming. The main objective of effectively utilizing palm oil waste is sustainable development (Umar et al., 2018; Umar et al., 2014; Lee and Ofori-Boateng, 2013).

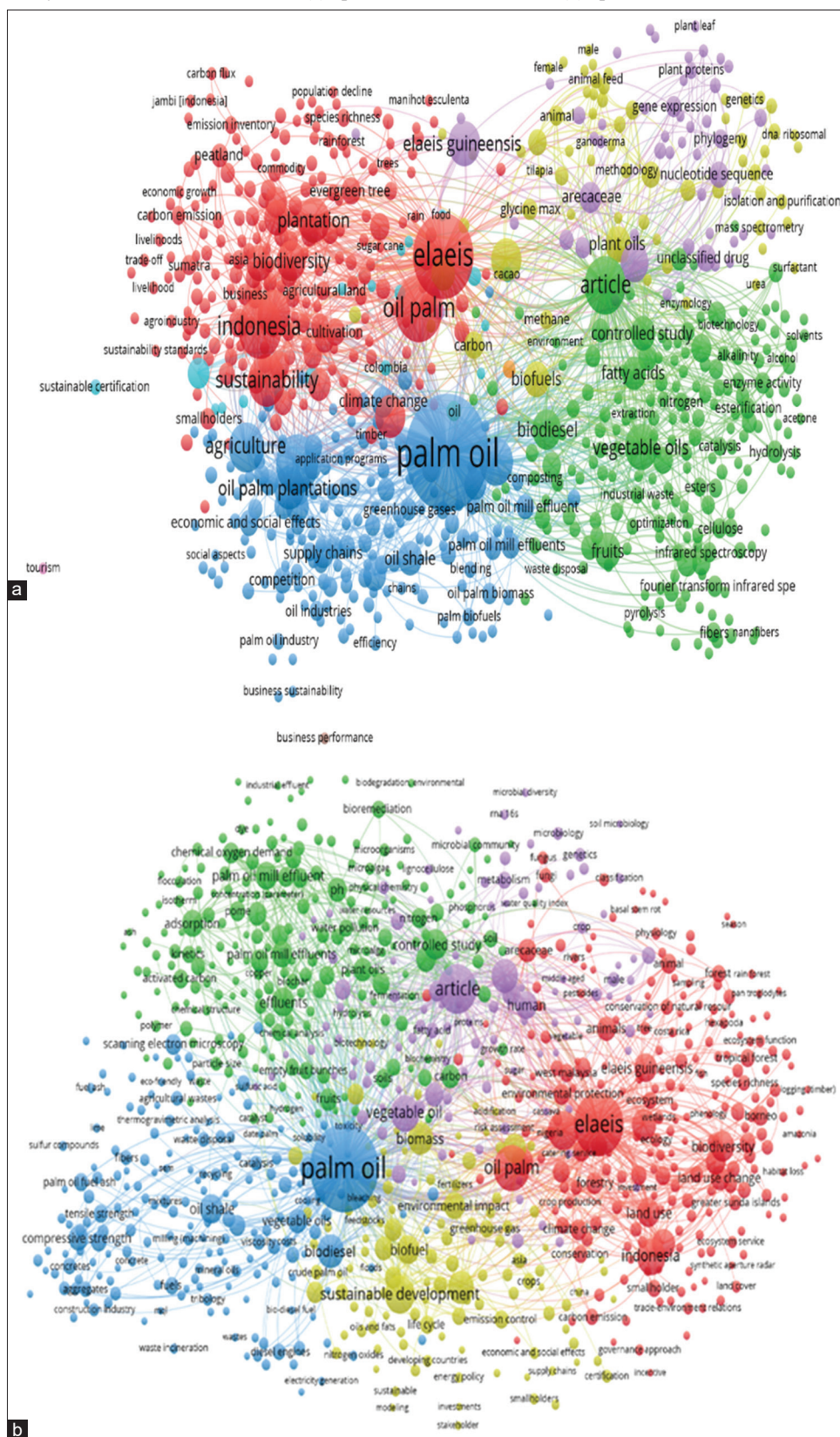
The keyword analysis was selected to decipher the literature on “palm oil” and “environmental quality” from 2000 to 2022. The findings revealed a total of 853 keywords divided into 5 clusters, with each color representing its cluster (Figure 3b). There are 10 keywords with the highest frequency, namely: (1) Palm Oil (567 occurrences); (2) Elaeis (295 occurrences); (3) Article/Research (179 occurrences); (4) Oil Palm (157 occurrences); (5) Malaysia (115 occurrences); (6) Sustainable Development (109 occurrences); (7) Vegetable Oil (101 occurrences); (8) Indonesia (100 occurrences); (9) Biodiesel (87 occurrences); and (10) Sustainability (83 occurrences).

The keywords “Elaeis,” “Oil Palm,” “Malaysia,” and “Indonesia” are from Cluster 1. This palm oil business can supply 86% of the world’s palm oil supply. Oil palm plantations in Indonesia and Malaysia emphasize anticipation of crop pest threats (Wong et al., 2021; Wong et al., 2022; Basyuni et al., 2019).

The keywords “Palm Oil” and “Biodiesel” are from Cluster 3. Increased demand for crude oil drives up prices. Therefore, many countries are looking for alternative energy sources. One of the alternative energy sources is palm oil. Palm oil is the main raw stock for biodiesel production as an alternative energy source (Mekhilef et al., 2011; Devarajan et al., 2017).

The keywords “Sustainable Development” and “Sustainability” come from Cluster 4. The various benefits provided by palm oil have driven its demand to increase significantly in the global market. However, most of the palm oil industry has not been able to implement sustainable standards. Therefore, integrating various palm oil production networks through effective waste utilization towards sustainable development should be implemented. Transformation towards sustainability in international palm oil governance can potentially drive sustainable development globally (Snashall and Poulos, 2021; Lee and Ofori-Boateng, 2013).

Figure 3: Keyword Network Visualization. (a) “palm oil” and “business.” (b) “palm oil” and “environmental quality”

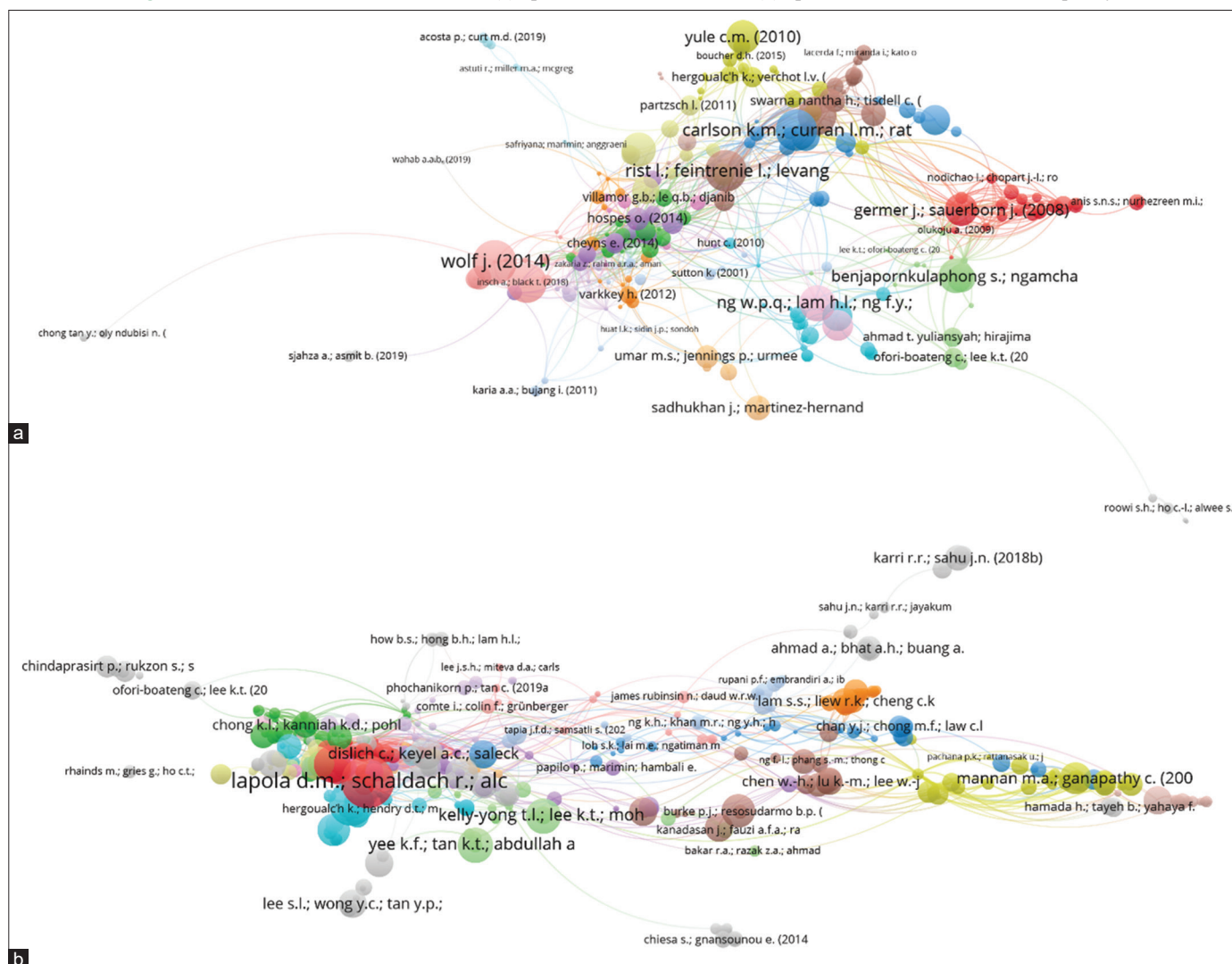


3.5. Citation Analysis

The citation analysis revealed a significant number of cited literature documents on the palm oil business during the observation period (Figure 4a). The findings show 23 clusters with 271 cited documents.

There are 10 literature documents with the highest citations, namely: (1) *The Relationship Between Sustainable Supply Chain Management, Stakeholder Pressure and Corporate Sustainability Performance* (Wolf, 2014) from cluster 10 with a total citation

Figure 4: Citation Network Visualization. (a) “palm oil” and “business.” (b) “palm oil” and “environmental quality”



of 333; (2) *Committed Carbon Emissions, Deforestation, and Community Land Conversion from Oil Palm Plantation Expansion in West Kalimantan, Indonesia* (Carlson et al., 2012) from cluster 3 with a total citation of 299; (3) *The Livelihood Impacts of Oil Palm: Smallholders in Indonesia* (Rist et al., 2010) from cluster 8 with a total citation of 291; (4) *Corporate Social Responsibility: Doing Well by Doing Good* (Falck and Heblich, 2007) from cluster 10 with a total citation of 270; (5) *Addressing the Threats to Biodiversity from Oil-Palm Agriculture* (Wilcove and Koh, 2010) from cluster 8 with a total citation of 256; (6) *Waste-to-Wealth: Green Potential from Palm Biomass in Malaysia* (Ng et al., 2012) from cluster 18 with a total citation of 219; (7) *Al₂O₃-Supported Alkali and Alkaline Earth Metal Oxides for Transesterification of Palm Kernel Oil and Coconut Oil* (Benjapornkulaphong et al., 2009) from cluster 11 with a total citation of 199; (8) *The Ecological Impact of Biofuels* (Fargione et al., 2010) from cluster 13 with a total citation of 199; (9) *Loss of Biodiversity and Ecosystem Functioning in Indo-Malayan Peat Swamp Forests* (Yule, 2010) from cluster 4 with a total citation of 193; and (10) *Estimation of The Impact of Oil Palm Plantation Establishment on Greenhouse Gas Balance* (Germer and Sauerborn, 2008) from cluster 1 with a total citation of 178.

The citation analysis also describes a significant number of cited literature documents on palm oil and environmental sustainability. During the observation period, 29 clusters were formed with 500 cited documents. The findings revealed 10 literature documents with the highest citations, which include: (1) *Indirect Land-Use Changes Can Overcome Carbon Savings from Biofuels in Brazil* (Lapola, et al., 2010) comes from cluster 1 with a total citation of 522; (2) *Subsidence and Carbon Loss in Drained Tropical Peatlands* (Hooijer, et al., 2012) is Cluster 6 with a total citation of 373; (3) *Addressing The Threats to Biodiversity from Oil-Palm Agriculture* (Wilcove & Koh, 2010) is Cluster 1 with a total citation of 256; (4) *Potential of Hydrogen from Oil Palm Biomass as a Source of Renewable Energy Worldwide* (Kelly-Yong, et al., 2007) comes from cluster 11 with a total citation of 230; (5) *Life Cycle Assessment of Palm Biodiesel: Revealing Facts and Benefits for Sustainability* (Yee, et al., 2009) comes from cluster 11 with a total citation of 228; (6) *Comparative Evaluation of Performance and Emission Characteristics of Moringa Oleifera and Palm Oil Based Biodiesel in a Diesel Engine* (Mofijur, et al., 2014) is Cluster 8 with a total citation of 214; (7) *Changes in Bird Communities Following Conversion of Lowland Forest to Oil Palm and Rubber Plantations in Southern Thailand* (Aratrakorn et al., 2006) is

cluster 13 with a total citation of 210; (8) *Trading Forests: Land-Use Change and Carbon Emissions Embodied in Production and Exports of Forest-Risk Commodities* (Henders, et al., 2015) comes from cluster 19 with a total citation of 196; (9) *A Review of The Ecosystem Functions in Oil Palm Plantations, Using Forests as a Reference System* (Dislich, et al., 2017) comes from Cluster 25 with a total citation of 195; and (10) *Loss of Biodiversity and Ecosystem Functioning in Indo-Malayan Peat Swamp Forests* (Yule, 2010) is Cluster 6 with a total citation of 194.

3.6. Countries Analysis

The countries analysis describes the number of countries contributing to the literature on palm oil business during the observation period (Figure 5a). The findings identify 61 countries that form 11 clusters, with each colour representing its respective cluster. Specifically, there were 5 countries that contributed the most, namely (1) Indonesia from cluster 9 with a total literature of 204 documents; (2) Malaysia from cluster 6 with a total literature of 187 documents; (3) the United States from cluster 4 with a total literature of 45 documents; (4) the United Kingdom from cluster 2 with a total literature of 45 documents; and (5) Australia from cluster 5 with a total literature of 40 documents.

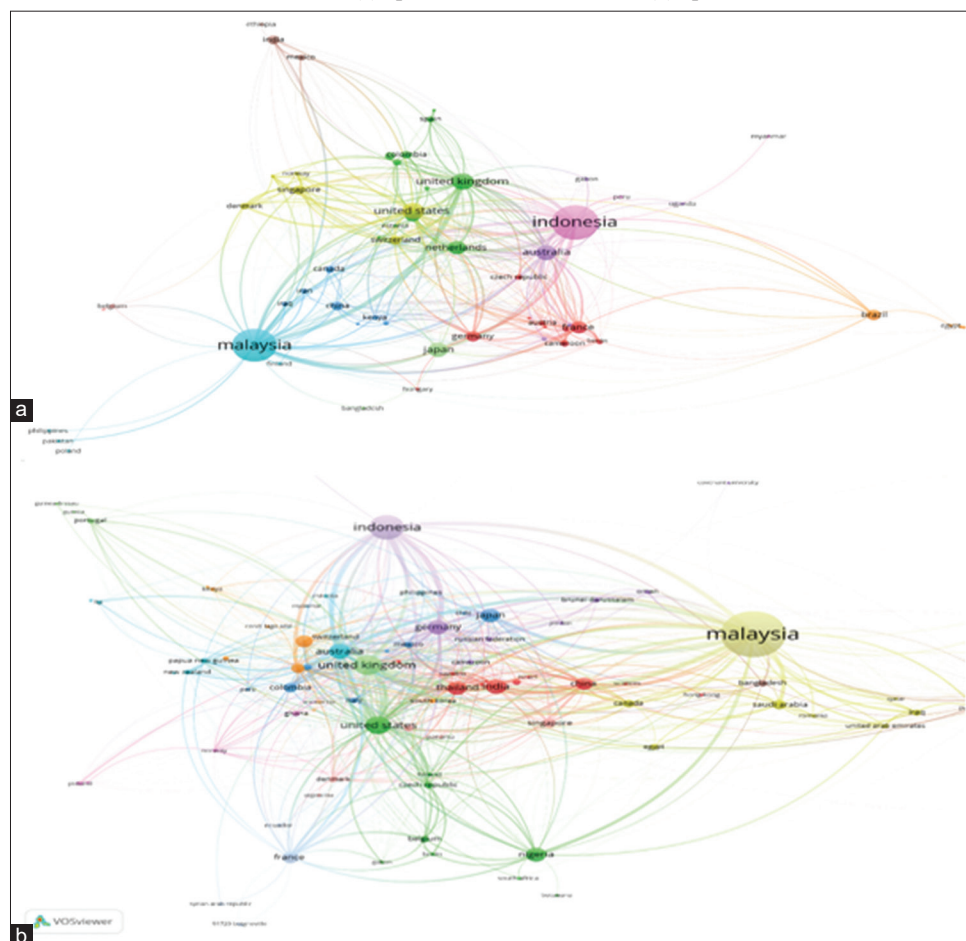
Indonesia is the world's leading palm oil-producing country. Afriyanti et al. (2016) mentioned that Indonesia could fulfil most of the global and Asian palm oil demand in the future. Meanwhile,

Malaysia is the world's second-largest palm oil producer (Kristanti et al., 2021). The United States, United Kingdom, and Australia are concerned about palm oil production's environmental impact and sustainability (Santeramo and Searle, 2019; Ostfeld et al., 2019; and Sundaraja et al., 2020). Specifically, Malaysia and the United States contributed significantly to the literature in 2014, the United Kingdom and Australia contributed significantly in 2015, and Indonesia contributed significantly in 2018.

Furthermore, the countries analysis also outlines a number of countries that contributed to the literature on palm oil and environmental quality during the observation period (Figure 5b). The findings identify 98 countries that form 16 clusters, with each color representing its respective cluster. There are 5 countries that have contributed the most, including: (1) Malaysia from cluster 13 with total literature of 647 documents; (2) Indonesia from cluster 14 with total literature of 186 documents; (3) the United Kingdom from cluster 11 with total literature of 125 documents; (4) the United States from cluster 2 with total literature of 96 documents; and (5) India from cluster 1 with total literature of 69 documents.

Malaysia and Indonesia are palm oil exporting countries that account for 84% of the global market (Kristanti et al., 2021). Meanwhile, India is the fourth country in oilseed production in the world market (Rathore et al., 2023). Furthermore, the United

Figure 5: Countries Network Visualization. (a) “palm oil” and “business.” (b) “palm oil” and “environmental quality”



States contributed significantly to literature in 2015, Malaysia and the United Kingdom contributed significantly in 2016, and Indonesia and India contributed significantly in 2018.

4. CONCLUSION AND RECOMMENDATION

The palm oil business sends many messages about the quality of a country's environment and economy. Several countries, especially in the Southeast Asian region, are centers of palm oil business development and exporters of palm oil products to the global market. Therefore, mapping the literature on the linkages between the palm oil business and environmental quality will contribute significantly. This study used a bibliometric approach to reveal the linkages between the palm oil business and environmental quality through documentation and literature search. The observation period is from 2000 to 2022.

The findings of the study can be described in several respects. First, the keyword group "palm oil and business" has a total of 672 literature documents, while the keyword group "palm oil and environmental quality" results in a total of 1,378 literature documents. Second, the time analysis describes an increasing pattern of scholars' concern and contribution to uncovering the relationship between palm oil and environmental quality. Third, international proceedings (IOP Conference Series Earth and Environmental Science) and international journals (Journal of Cleaner Production) have contributed significantly to publishing literature documents. Fourth, two articles that received many citations were: (a) The Relationship between Sustainable Supply Chain Management, Stakeholder Pressure and Corporate Sustainability Performance (Wolf, 2014); and (b) Indirect Land-Use Changes Can Overcome Carbon Savings from Biofuels in Brazil (Lapola et al., 2010). Finally, Indonesia and Malaysia are two countries that scholars widely study regarding the relationship between palm oil and environmental quality.

The implications of the study findings can be constructed into several ways. First, scholars can build on the findings of this study to further study the link between the palm oil business and environmental quality. Second, the government of palm oil-producing countries should encourage the palm oil business within the framework of a sustainable environment. Third, palm oil businesses should develop palm oil businesses that are environmentally friendly and lead to the availability of alternative energy sources.

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