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A Bibliometric Analysis of Management Bioenergy Research Using Vosviewer Application

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ABSTRACT

This study aims at analyzing and demonstrating bibliometric data analysis step by step using VOSViewer systematically. Step-by-step analysis was provided to make first-time users access and utilize VOSViewers more easily. This study provides data analysis regarding management bioenergy and its development throughout five years (2017–2021) by utilizing mapping tools in the VOSViewer. The method used was qualitative descriptive to describe the bibliometric analysis performance by producing network visualization of the chosen topic. From the search results, 1000 relevant published journals were found, ranging from 2017–2021, which were then grouped into five categories according to their published year. After grouping the journal data, we discovered that the total number of articles published on the topic of bioenergy management from 2017 to 2021 was 180. As a result, it conclude that management bioenergy is a field that can be combined with another field to be studied. This way, there is a lot of opportunities to find novelties in this topic. Furthermore, this study is expected to serve as a resource for researchers conducting research and determining the research theme.

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1. INTRODUCTION

As technology grows rapidly, bibliometric analysis that displays mapping tools visually is needed, especially in the field of science. Therefore, software, as the essential component of the modern science ecosystem, that has a scientific purpose application, must be designed to assist with non-trivial scientific tasks. One of a software application that can help scientists as a mapping tool is VOSviewer. In this case, mapping tools are useful to get various information regarding the development of science that has been carried out (Al Husaeni & Nandiyanto, 2022). VOSviewer is a popular software tool that is used to analyze the novelty of research. It also helps to visualize bibliographies (containing title, author, journal, etc.) (Al Husaeni & Nandiyanto, 2022; Van Eck & Waltman, 2017; Hamidah et al., 2020; Mustafa & Erbay, 2020). Bibliography comes from the Ancient Greek words, namely "bilio" (book) and "grafi" (writing). Therefore, a bibliography can be interpreted as a list of articles, books, and magazines that usually present a particular topic (Beebe, 2021; Al-Ashmori, et al., 2020).

VOSviewer software plays an important role in processing data related to data collection, formation, management, analysis, simulation, etc (Mustafa & Erbay, 2020). With this software, scientists can also find novelties in research because this application can represent a certain topic impact. Furthermore, once inputting data, this application is also capable of finding new trends, keywords, as well as the evolutionary process of a certain topic frequency. Furthermore, VOSviewer software is useful for presenting bibliographic visualizations (Al-Ashmori et al., 2020; Orduña-Malea & Costas, 2021). In the world of research, VOSviewer is used for bibliometric analysis, looking for research areas that still have the opportunity to be researched and linked to get updates, as well as looking for library

materials that are most widely used in the intended field.

Bioenergy is one of many diverse resources available to assist in meeting our energy demand. It is a type of renewable energy derived from recently living organic materials known as biomass, and it can be used to generate transportation fuels, heat, electricity, and products (Rose et al., 2014). Bioenergy is created by converting biomass into renewable energy that can be used in a variety of applications. Bioenergy will play an important role in the management of global climate change in the future. The majority of the research modelling bioenergy is a transformation of fossil energy into a more environmentally friendly form for daily consumption. Bioenergy use is expected to reach 30% in 2050 and 50% in 2100 and will continue to rise in the future (Rose et al., 2014). In addition to the significance of bioenergy trends, it is necessary to investigate terms in the field of bioenergy management research in order to produce the most recent renewables. Therefore, finding novelties in bioenergy research is important. Thus, we examined management bioenergy research trends and novelty using VOSviewer.

Previous studies regarding VOSviewer in various fields have been conducted. Many papers discussed about bibliometric analysis, such as:

- (i) Digital learning (Al Husaeni and Nandiyanto, 2022)
- (ii) Computer science (Al Husaeni and Nandiyanto, 2023a)
- (iii) Vocational school (Al Husaeni and Nandiyanto, 2023b)
- (iv) High school (Al Husaeni and Nandiyanto 2023c)
- (v) Covid-19 research (Hamidah et al., 2020)
- (vi) Scientific publications (Mulyawati and Ramadhan 2021)
- (vii) Chemical engineering (Nandiyanto et al., 2021)

- (viii) Materials research (Nandiyanto and Al Husaeni, 2021)
- (ix) Special needs education (Al Husaeni et al., 2023a)
- (x) Publication of techno-economic education (Ragahita and Nandiyanto, 2022)
- (xi) Engine performance (Setiyo et al., 2021),
- (xii) Dataset portrays decreasing number of scientific publication (Nandiyanto et al., 2020a)
- (xiii) Application in robotic hand systems (Castiblanco et al., 2021)
- (xiv) Research effectiveness in a subject area among top class universities (Nandiyanto et al., 2020b)
- (xv) Educational Research (Al Husaeni et al., 2023b)

Eck and Watman conducted a study regarding VOSviewer as a computer program for bibliometric mapping. They did an analysis regarding the usage of VOSviewer software as well as technical implementation of the software (Van Eck & Waltman, 2010). Van Eck and Watman also used VOSviewer as their research object to indicate research activities at Laiden University. However, they used the VOSviewer 1.4.0 version in their study (Wu et al., 2011). Similar to the previous study, Hu et al. also conducted a study using the VOSviewer software application. In their study, they used VOSviewer to determine which scientists write articles regarding a certain topic (Hu et al., 2019). Meanwhile, Huang et al. also conducted a study regarding the global trend of sacral fracture surgery on VOSviewer (Huang et al., 2020; Gabriella et al., 2021). However, in this study, we used the latest version of VOSviewer, which is 8.0.0, while using management bioenergy as the case study. This study provides a mapping tool not only limited to the trend of chosen topics but also covers the evolutionary process of a certain topic.

The aim of this study is to analyze and demonstrate bibliometric data analysis step by step using VOSViewer systematically. The method used is qualitative descriptive to describe the bibliometric analysis performance by producing network visualization of the chosen topic.

2. METHODS

We used a qualitative descriptive method to describe the data used in this study. We gathered journal data, which is based on research from publications that have been published in Google Scholar-indexed journals. Detailed information on the library quest for searching data is explained in previous studies (Azizah et al., 2021; Al Husaeni & Nandiyanto, 2022). The journal data was related to management bioenergy. To gather the data, we used the reference manager application system as the reference, namely Publish or Perish. In this application, we can choose related articles or journals data from Crossref, Google Scholar, Google Scholar Profile, PubMed, Microsoft Academic, Scopus, and Web of Science. Publish or Perish is used to conduct a literature review of the chosen theme. Therefore, a similar research database was obtained.

Google scholar, in this study, was chosen because it is free to use, unlike Scopus, which publishes or requires a subscription. The journals related to the chosen topic ranged from 2017–2021, and 900 articles were discovered within that period of time. The criteria of the journal are that every journal data must be indexed by Google Scholar and be in compliance with the search for the themes needed in this study, which is management bioenergy. The data is then inputted into VOSviewer. After inputting it, the data is processed so that it can match the desired or chosen keywords. Furthermore, VOSviewer then converted the inputted data into an interconnected data map.

Furthermore, we examined the difference in the number of publications each year and classify the 15 articles with the highest number of citations for each publisher from a total of 1000 articles.

3. RESULTS AND DISCUSSION

Based on data obtained from a search using the Publish and Perish software, 1000 articles on the topic of bioenergy management published in journals between 2017 and 2021 were discovered. Every year, articles on bioenergy are fairly evenly distributed. From 2017 to 2021, the number of published journals was 181, 157, 200, 198, and 162, respectively.

Table 1 displays the data for the most cited articles in the field of bioenergy management. The number of research topic keywords that can be linked to VOSviewer was limited to two. Following that, a data set of research articles was gathered in order to analyze the relationship between the terms.

The data obtained on the topic of bioenergy management was divided into seven clusters, namely:

- (i) Cluster 1 has 33 items, the 33 items are bio, bioenergy feedstock production, biogas production, carbon capture, circular economy, comprehensive review, effective waste management, energy recovery, environmental performance, food waste, forest, ghg emission, greenhouse gas emission, improvement, land use, life cycle assessment, manure management, measure, mitigation, municipal solid waste, municipal solid waste management, reduction, solid waste management, suitability, sustainable bioenergy, sustainable development, sustainable forest management, transition, uncertainty, valorisation, waste management system, and wood.
- (ii) Cluster 2 has 22 items, the 22 items are agricultural waste, bioenergy recovery, biofuel production, carbon, crop residue, efficient management, enhancement, feedstock, form, fossil fuel, fuel, heat, heavy metal, lignocellulosic biomass, management option, methane, nanotechnology, pretreatment, pyrolysis, renewable energy, risk management, and waste water treatment.
- (iii) Cluster 3 has 17 items, the 17 items are base management practice, bioenergy potential, biomass yield, effectiveness energy management, engineering, fertilizer, interaction, miscanthus, nutrient management, nutrient management practice, perennial bioenergy crop, present study, quality, risk, science, and variety.
- (iv) Cluster 4 has 14 items, the 14 items are availability, bioenergy crop, bioenergy purpose, bioenergy supply chance, evident, farmer, food, forage, harvest, implication, marginal land, sugarcane, and switchgrass.
- (v) Cluster 5 14 items, the 14 items are bioenergy feed stock, bioenergy yield, corn, corn stover, crop, crop management, nitrogen, nitrogen management, residue management, soil carbon, sweet sorghum, tillage, united states, and yield.
- (vi) Cluster 6 has 11 items, the 11 items are agricultural management, biodiesel, biomass production, data, environmental assessment, gasification, land, microalgae, soil management, sustainable energy, and transportation.
- (vii) Cluster 7 has 11 items, the 11 items are biodiversity, bioenergy production system, bioenergy sector, climate change, ecosystem service, farm, framework, green supply change management, information, policy, and proper management.

Table 1. The most cited articles of bioenergy management.

No	Cites	Title	Source	Year
1	277	A state-of-art literature review reflecting 15 years of focus on sustainable supply chain management (Ansari & Kant, 2017)	Journal of cleaner production	2017
2	233	Supply chain risk management and artificial intelligence: state of the art and future research directions (Baryannis et al., 2019)	International Journal of Production Research	2019
3	178	Improved light-harvesting and thermal management for efficient solar-driven water evaporation using 3D photothermal cones (Wang et al., 2018)	Journal of Materials	2018
4	175	Constructed floating wetlands: a review of research, design, operation and management aspects, and data meta-analysis (Pavlineri et al., 2017)	Chemical Engineering Journal	2017
5	175	Volatile fatty acids production from food wastes for biorefinery platforms: A review (Strazzera et al., 2018)	management	2018
6	140	Tillage, crop residue, and nutrient management effects on soil organic carbon in rice-based cropping systems: A review (Ghimire et al., 2017)	Journal of integrative	2017
7	134	Biochar for environmental management: Mitigating greenhouse gas emissions, contaminant treatment, and potential negative impacts (Zhang et al., 2019)	Engineering Journal	2019
8	132	Information systems and sustainable supply chain management towards a more sustainable society: Where we are and where we are going (de Camargo Fiorini & Jabbour, 2017)	Journal of Information Management	2017
9	128	Municipal wastewater sludge as a sustainable bioresource in the United States (Seiple et al., 2017)	of Environmental Management	2017
10	127	Biochar as a tool to reduce the agricultural greenhouse-gas burden“knowns, unknowns and future research needs (Kammann et al., 2017)	Management	2017
11	126	International evolution of fat, oil and grease (FOG) waste management“A review (Wallace et al., 2017)	environmental management	2017
12	103	Methods for determination of biomethane potential of feedstocks: a review (Jingura & Kamusoko, 2017)	Biofuel Research Journal	2017
13	102	Management and control of microbiologically influenced corrosion (MIC) in the oil and gas industry”Overview and a North Sea case study (Skovhus et al., 2017)	Journal of biotechnology	2017
14	95	Optimizing management to enhance multifunctionality in a boreal forest landscape (Triviño et al., 2017)	Journal of Applied	2017
15	89	Potential for using municipal solid waste as a resource for bioenergy with carbon capture and storage (BECCS) (Pour et al., 2018)	International Journal of Greenhouse Gas	2018

In Cluster 3, quality was at the centre of the term that was most commonly used as a research topic for bioenergy management and had numerous connections with other terms. According to the graph, quality was linked to 15 other terms (see **Figure 6**). Evidence, risk, variety, gasification, policy, measure, land use, feedstock, biomass production, nutrient management, biomass yield, yield, bioenergy crop, bioenergy feedstock, and residue management were all quality keywords.

Meanwhile, in Cluster 4, the bioenergy crop became the main centre of the term that was most frequently raised as a topic of research on bioenergy management and had numerous connections with other terms. **Figure 7** depicts the relationship between

bioenergy and other words. **Figure 7** depicts the relationship between bioenergy crops and 27 other crops. **Figure 7** shows how bioenergy crops were linked to 27 other concepts. Risk, bioenergy industry, food, biodiversity, quality, land, surgance, crop, miscanthus, biomass yield, bioenergy feedstock, farmer, soil carbon, nitrogen, corn, nitrogen management, mitigation, information, climate change, carbon, farm, yield, land use, reduction, enhancement, biofuel production, and heavy metal.

In Cluster 5, yield was the centre point of the term that was most widely used as a research topic for bioenergy management and had numerous connections to other terms.

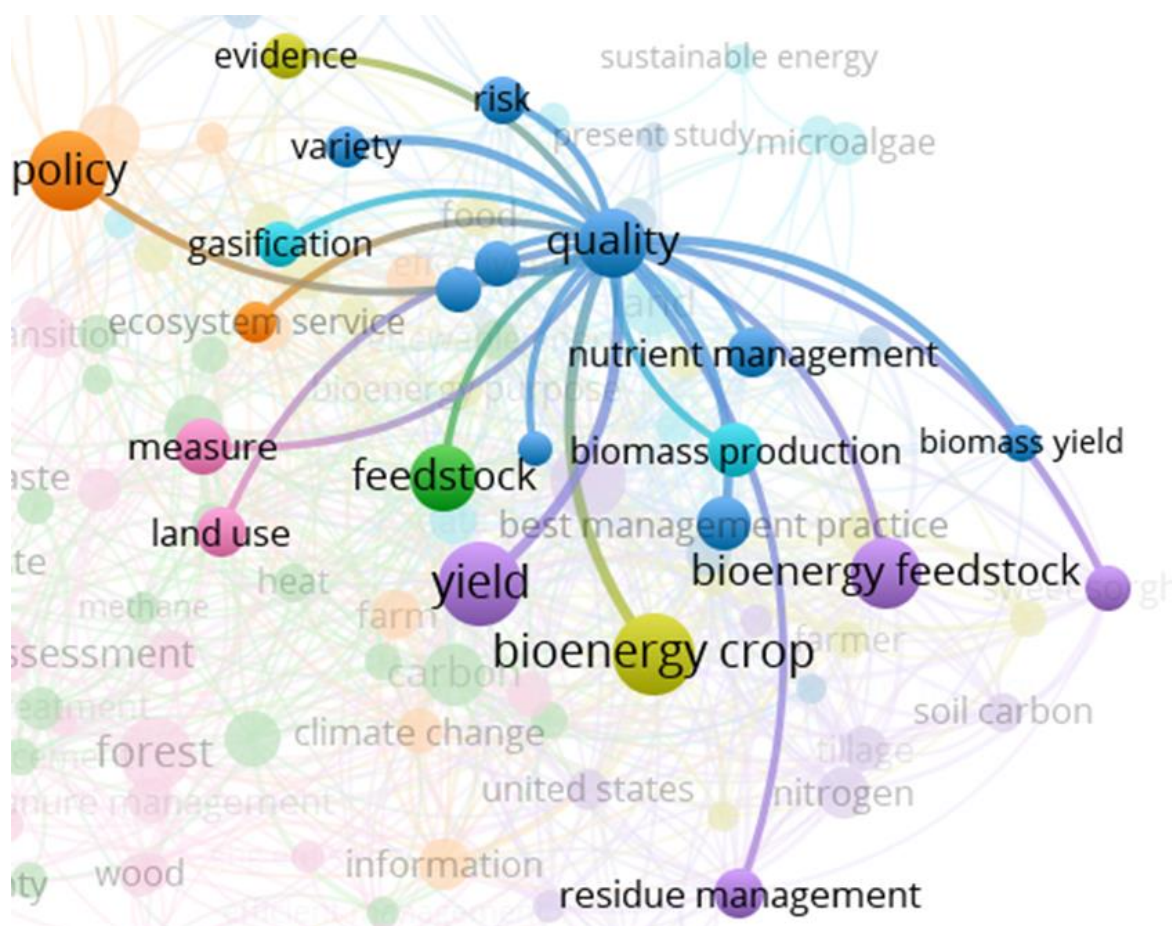


Figure 6. Network visualization of cluster 3.

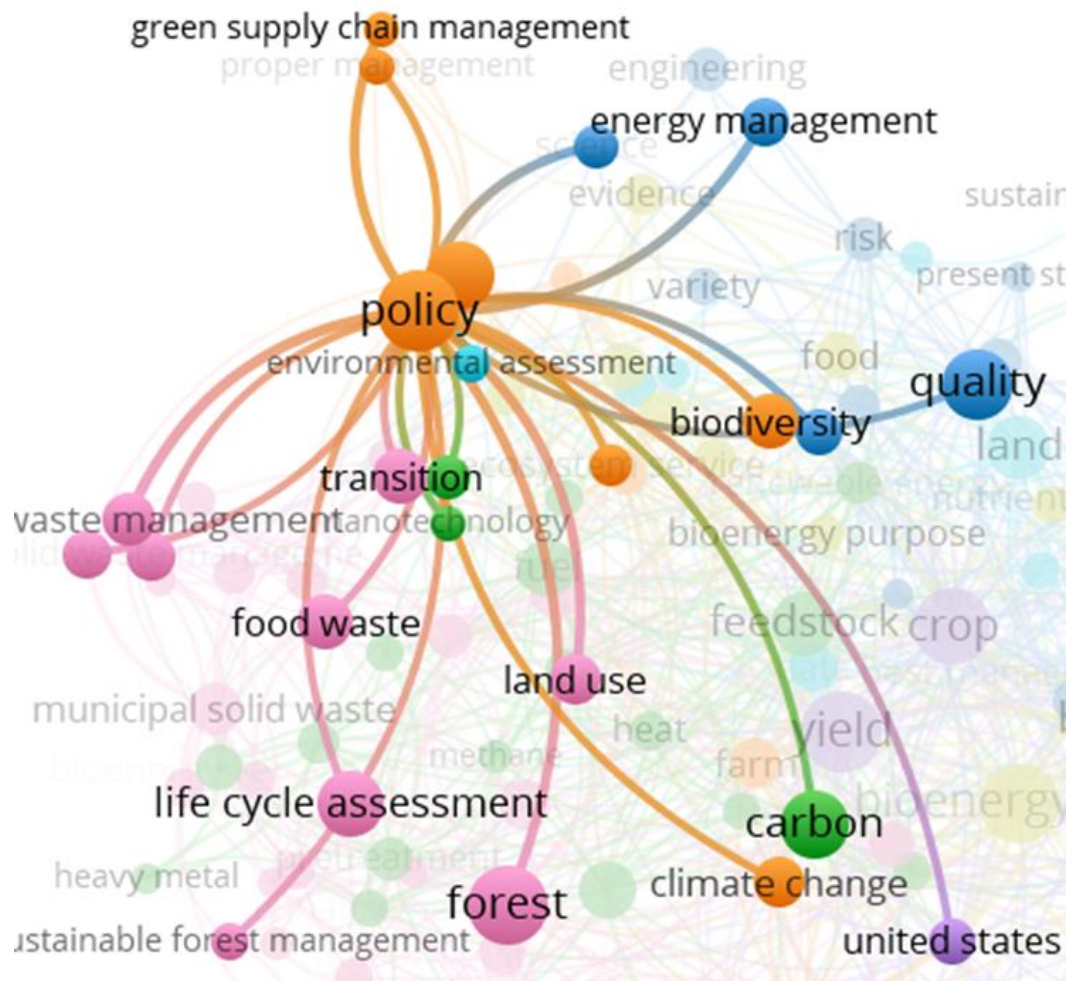


Figure 10. Network visualization of cluster 7.

4. CONCLUSION

The purpose of this research was to examine the bibliometric literature on bioenergy management. In this study, bioenergy was divided into two categories: bioenergy crops and bioenergy feedstock. In the search process, the keyword "management bioenergy" was used, which was based on a topic area with titles, keywords, and abstracts. Following the search, 900 articles were discovered to be relevant. The mapping procedure was then completed using VOSviewer. The search yielded 15 papers with the most citations. Based on the results of analysis and mapping with VOSviewer, bioenergy management research with term study was identified as the most studied in the 2017–2021 period.

Meanwhile, the bioenergy crop was the most researched in the field of bioenergy management. The VOSviewer analysis identified seven keyword Clusters related to the research topic of bioenergy management. Each Cluster contains a main term that was linked to other terms. Forest, Carbon, Quality, Bioenergy Crop, Yield, Land, and Policy were all terms found in Cluster 1. Meanwhile, for Cluster 2-7, the terms included were forest, Quality, Bioenergy Crop, Yield, Land, and Policy, respectively.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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