Two Decades of Bibliometric Research in Indonesia

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ABSTRACT

Bibliometric research in Indonesia is essential to do for exploring trends and understanding the knowledge base of bibliometric research from the perspective of globally indexed publications. Bibliometric studies have been applied mainly to scientific fields of activity, mostly based on metadata elements such as author, title, subject, citation, etc., related to scientific publications in a discipline. However, no study explicitly discusses the development of bibliometric research in Indonesia based on globally indexed publications. This study aims to identify 1) the growth of bibliometric research in Indonesia, 2) the performance of scientific agencies in publishing bibliometric research in Indonesia, and 3) the science mapping of bibliometric research in Indonesia. This study used data and graphical quantification methods to help researchers understand the future progress and trends of bibliometric research in Indonesia. The study results show that within two decades, there have been 167 relevant documents published and globally indexed in this field. The 167 documents were then analyzed and interpreted using bibliometric techniques: performance analysis and science mapping. The performance analysis results show that bibliometric publications in Indonesia continue to increase from one publication in 2001 to 85 documents in 2022. The most popular categories studied with bibliometrics are Environmental science and Engineering. The analysis results also show the productivity of each scientific actor, including writers, institutions, and countries. The conclusion showed four significant clusters in bibliometric research in Indonesia: the Chemical science cluster, Bibliometric analysis and literature review, food safety, and top Indonesian universities.

ABSTRAK

Penelitian bibliometrik di Indonesia penting dilakukan untuk mengeksplorasi tren dan memahami basis pengetahuan penelitian bibliometrik dari perspektif publikasi yang terindeks secara global. Studi bibliometrik telah diterapkan terutama pada bidang kegiatan ilmiah, sebagian besar didasarkan pada elemen metadata seperti penulis, judul, subjek, kutipan, dll., terkait dengan publikasi ilmiah dalam suatu disiplin ilmu. Namun, belum ada penelitian yang secara eksplisit membahas perkembangan penelitian bibliometrik di Indonesia berdasarkan publikasi yang terindeks secara global. Penelitian ini bertujuan untuk mengidentifikasi 1) pertumbuhan penelitian bibliometrik di Indonesia, 2) kinerja lembaga ilmiah dalam menerbitkan penelitian bibliometrik di Indonesia, dan 3) pemetaan keilmuan penelitian bibliometrik di Indonesia. Penelitian ini menggunakan metode kuantifikasi data dan grafis untuk membantu peneliti memahami perkembangan dan tren penelitian bibliometrik di Indonesia ke depan. Hasil studi menunjukkan bahwa dalam dua dekade, telah ada 167 dokumen relevan yang diterbitkan dan terindeks secara global di bidang ini. Ke-167 dokumen tersebut kemudian dianalisis dan diinterpretasikan menggunakan teknik bibliometrik: analisis kinerja dan pemetaan sains. Hasil analisis kinerja menunjukkan bahwa publikasi bibliometrik di Indonesia terus meningkat dari satu publikasi pada tahun 2001 menjadi 85 dokumen pada tahun 2022. Kategori yang paling banyak dipelajari dengan bibliometrik adalah Ilmu Lingkungan dan Teknik. Hasil analisis juga menunjukkan produktivitas masing-masing pelaku keilmuan, baik penulis, lembaga, maupun negara. Kesimpulan menunjukkan empat klaster penting dalam penelitian bibliometrik di Indonesia: klaster ilmu kimia, *Bibliometric analysis and literature review,* keamanan pangan, dan universitas terkemuka di Indonesia.

Keywords: Bibliometric research; Citation; Historiography; Indonesia; WOS.

1. INTRODUCTION

In 2020, Indonesia will enter a new era of national development. During the 2014-2019 period, the national result was more focused on infrastructure. Still, for the second period, President Joko Widodo's government shifted its focus to developing Indonesia's human resources and mastering science and technology. The 2020-2024 National Medium-Term Development Plan (RPJMN)

establishes four pillars of national development: 1. Human development and mastery of science and technology; 2. Sustainable economic growth; 3. Development based on the principles of fairness and equity; and 4. National security and excellent state administration. The quality of research and development of a country is a national asset. The National Science and Technology Law places science and technology as an asset in which to invest for national development (Articles 5 and 6). The new law establishes the National Research and Innovation Agency (BRIN) (Article 48) and shows the National Endowment Fund for Research, Development, Study, and Application (Article 62). The National Research and Innovation Agency (BRIN) was officially established in 2019 based on Presidential Regulation 74 of 2019. Although the Presidential Decree regulates the position, duties, authorities, organizational structure, and work procedures of BRIN, the final institutional form of the agency has not been fully formed. Moreover, the draft legislation that will provide more specific rules regarding implementing the provisions of Law Number 11 of 2019 (Sisnas Science and Technology)—(RPP)—is still under discussion. Research and development require investment as a critical asset in the knowledge economy (Huda et al., 2020).

Improving the quality of science is one of the agendas of the current Indonesian regime under President Joko Widodo (Jokowi). Under its development plan, Nawa Cita, research and development (R&D) has been seen as playing an essential role in two ways, namely to increase productivity and competitiveness (pillar no. 6 of the plan) and to achieve economic resilience (pillar no. 7) (Siregar, 2016). Analysis of research progress will help all parties involved, especially researchers, to obtain an objective view of the quality and quantity of research. In particular, bibliometric analysis allows researchers to analyze research in a specific field. Bibliometrics analysis related to authors, journals, affiliations, frequently used keywords, types of publications, and collaborating countries (Khuluq et al., 2022). So far, most studies have neglected the academic landscape of the field from the viewpoint of its intrinsic bibliographical characteristics. This article aims to close that gap. In particular, this article aims to present a topical representation of the literature that explicitly acknowledges being part of bibliometric research by eliciting the topic of patterns in field citation networks, hierarchical semantic relationships, and combinations of the two. In doing so, we provide topical representations that are not forced into predefined classifications but respond to the field's organic developments (Mejia et al., 2021).

Through qualitative and quantitative analysis of scientific literature, bibliometrics has been widely used to understand the knowledge base and to explore development trends and research frontiers in various research fields (Donthu et al., 2021). However, no bibliometric study explicitly discusses the development of bibliometric research in Indonesia based on globally indexed publications. Questions from the study are 1) How does bibliometric research grow in Indonesia? 2) how is the performance of scientific agencies in publishing bibliometric research in Indonesia? 3) What is the science mapping of bibliometric research in Indonesia?

This research is essential to explore development trends and understand the knowledge base of bibliometric research in Indonesia from the perspective of globally indexed publications. Overall, this study comprehensively analyses bibliometric research fields in Indonesia over the past two decades.

2. LITERATURE REVIEW

Bibliometrics is the statistical analysis of books, articles, or other publications. The study tracks the output and impact of the author or researcher. It can help with promotion and ownership, as well as help with funding and grants. Bibliometrics is also used to calculate journal impact factors, which can help you decide which journal to publish (Embry-Riddle, 2023). Bibliometrics has been widely used to understand the knowledge base and to explore development trends and research frontiers in various research fields through qualitative and quantitative analysis of the scientific literature (Bai et al., 2023). Bibliometrics uses statistical methods to analyze bibliometric publication data such as peer-reviewed journal articles, books, conference proceedings, magazines, reviews, reports, and related documents. It has been widely used to present research domain relationships with quantitative methods (IGI Globa, 2023).

Bibliometric studies have been applied mainly to scientific fields. They are primarily based on metadata elements such as author, title, subject, citation, etc., and associated with scientific publications in a discipline. Science mapping uses the bibliometric method to examine how disciplines, fields, specialities, and individual papers are related (Zupic, 2015). Authorship includes who writes and who is given scientific contributions that are more widely published in scientific research journals. Authors are responsible for determining authorship and deciding on their study with two or more other authors to contribute (Natakusumah, 2015). Synthesizing previous research findings is one of the essential tasks for advancing a particular line of research (Zupic, 2015). Research sources come from one journal or many journals or databases. This paper discusses research limited to single journal sources. Author productivity also called scientific productivity, is used in many research studies. The writer's productivity is determined based on some scientific contributions by researchers in certain fields of study, such as informatics, computers, and control systems (Natakusumah, 2015).

Bibliometric analysis has gained immense popularity in business research in recent years (Donthu, Kumar, & Pattnaik, 2020b; Donthu, Kumar, Pattnaik, & Lim, 2021; Khan et al., 2021), and its popularity can be attributed to (1) the advancement, availability, and accessibility of bibliometric software such as Gephi, Leximancer, VOSviewer, and scientific databases such as Scopus and Web of Science, and (2) cross-pollination of bibliometric methodologies from information science to business research. More importantly, the popularity of bibliometric analysis in business research is not a fad but a reflection of its usefulness for (1) handling large volumes of scientific data and (2) generating high research impact. The data that is the centre of attention in

bibliometric analysis tend to be massive (e.g., hundreds, if not thousands) and objective (e.g., number of citations and publications, the occurrence of keywords and topics). However, interpretation often depends on both objectives. (e.g., performance analysis) and subjective evaluations (e.g., thematic analysis) established through informed techniques and procedures. In other words, bibliometric analysis helps decipher and map the cumulative scientific knowledge and evolutionary nuances of selected fields by precisely understanding large amounts of unstructured data. Therefore, a well-conducted bibliometric study can build a solid foundation for advancing a field in new and meaningful ways. For example, it enables and empowers scholars to (1) get a one-stop review, (2) identify knowledge gaps, (3) get novel ideas for investigation, and (4) position their desired contribution to the field (Donthu et al., 2021).

3. METHOD

The bibliometric methodology is considered helpful as a support tool for decision-making in setting research priorities, tracking the evolution of science and technology, allocating funding, and rewarding scientific excellence, among other things. Given their versatility, these methods quickly spread beyond the information and library science domains from where they started. This deployment is partly due to a large amount of data and easy accessibility (Mejia et al., 2021). Bibliometrics, a set of methods used to study or measure texts and information, has become a standard tool in science policy and research management in recent decades (Natakusumah, 2015). The bibliometric method uses a quantitative approach to describing, evaluating, and monitoring published research. These methods have the potential to introduce a review process that is systematic, transparent, and reproducible, thereby increasing the quality of the review. The bibliometric approach helps review the literature before the reading begins by guiding the researcher to the most influential works and charting research areas without subjective bias (Zupic, 2015). This method can solve crucial problems in scientific publications, such as measuring the distribution of articles, the classification of article categories, the distribution of article subjects, the pattern of authorship, and the distribution of contribution agencies (Natakusumah, 2015). However, when appropriately implemented, the bibliometric method offers many benefits to other disciplines and cannot be considered outdated. In this direction, bibliometrics has the task of documenting developments in this field and explaining its characteristics as it develops (Mejia et al., 2021).

The stages of research conducted consisted of five stages, adopting (Effendi et al., 2023). The five steps are determining search terms, obtaining the first search results, filtering, compiling initial statistical data, and analyzing data.

1) Determination of search keywords

    Data searches were conducted on the Web of Science (WoS) database on Feb 15, 2023, using the keywords 'bibliometric' and 'Indonesia.' WoS was chosen because it is an indexing

database with an objective evaluation process to meet the highest standards. The queries used at the beginning of the search are bibliometric (Topic) and Indonesian (All Fields).

2) Initial search results

This research obtained 213 documents from the WoS database in the initial search published in 2001-2022. The search starts by opening the WoS website at https://www.webofscience.com/wos/woscc/basic-search, then selecting the Topic search field and typing in 'bibliometric' in the search field. Next, add a search field using the Boolean Term (AND) followed by selecting the All Fields to search and typing 'Indonesia' in the search fields. Some of the titles/abstracts are known not to be bibliometric research and/or the objects are not in Indonesia. The indicator is that documents must use the bibliometric method, and their objects are related to Indonesia. So this research will sort the documents in the next step.

3) Improved search results

The next step, this study, narrows the search results by removing documents that are not suitable for the screening criteria. From the initial 213 documents, we filter the search using country/regional filters and the year of publication. The filter in query used: bibliometric (Topic) and Indonesia (All Fields), and INDONESIA (Countries/Regions) and 2022 or 2016 or 2017 or 2018 or 2019 or 2001 or 2004 or 2015 or 2020, or 2021 (Publication Years). Then the writer re-selects the documents based on the title and abstract that match the criteria so that the final documents used for further analysis were 167 documents.

4) Compile initial statistical data

The resulting search after the fix is then downloaded, saved in the Mendeley application, and exported to BibTex format to include all important information related to the paper, including title, author name, abstract, keywords, and journal specifications (published journal, year of publication, volume, issue, and pages).

5) Data analysis

This step presents a bibliometric analysis for the keywords 'bibliometric' and 'Indonesia.' Bibliometric analysis was performed using the HistCite application. HistCite was chosen because it has a feature that can visualize the historiography of reference sources. The studies included performance analysis (authors, institutions, and countries) and science mapping (co-citation and co-word analysis).

This study uses Local Citation Score (LCS) graphs and Global Citation Score (GCS) graphs to present science mapping. According to Mesquita et al. (2017), LCS and GCS graphs can present citation relationships between documents, authority articles (the theoretical basis for other research), and hub or connection articles, which connect with more recent studies. So this study uses both to understand the knowledge base of this topic, including knowing the initially published topics, authority articles, articles hub, and citation relationships.

4. RESULTS AND DISCUSSION

1. Research Growth

The number of publications and trends are important indicators of the development status of a discipline (Fang et al., 2022). As previously mentioned, the WoS database resulted in 167 publications in Indonesian bibliometric research. Between 2001 and 2022, documents published included 92 journal articles, 44 review articles, 31 reports, six pre-publications, and 1 data paper. The total number of publications per year correlates with bibliometric research trends in Indonesia. Figure 1 illustrates the increasing trend over the last two decades graphically. In 2022, the peak publication of this field was 85 documents, up 43.35% from the previous year. However, 2021 is the year with the most global quotes, namely 180 citations.
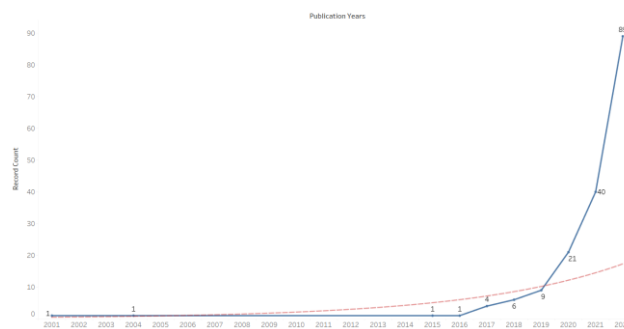
Figure 1. Bibliometric research trends in Indonesia
Source: WoS database

Table 1 presents a summary of the top 10 categories in the field of bibliometric research in Indonesia. Environmental sciences are the most popular category, with 21 publications accounting for 13% of the total publications. Green sustainable science technology is the second most popular category, with 15 publications (9%). The third Environmental studies with 14 publications (8%). The environmental and engineering categories dominate 54% of the overall documents, while business and management science is 18%. It shows that the environmental and engineering categories are most relevant to bibliometric research in Indonesia.

Table 1. The top 10 categories in the field of bibliometric research in Indonesia

Web of Science Categories	Record Count	% of 167
Environmental Sciences	21	13%
Green Sustainable Science Technology	15	9%
Environmental Studies	14	8%
Engineering Multidisciplinary	13	8%
Business	12	7%
Computer Science Theory Methods	10	6%
Multidisciplinary Sciences	10	6%
Chemistry Multidisciplinary	9	5%
Computer Science Information Systems	9	5%
Economics	8	5%

Source: WoS database

2. Performance Analysis

Table 2 describes the ten most productive authors based on the number of records and Total local citation score (TLCS). Purnomo took first place with eight records (4.8%), followed by Nandiyanto with six records (3.6%), Lukardi with five records (3%), Prahani with five records (3%), and Ahmad with four records (2.4%). Purnomo publishes most of his articles in global publications (7) and global journals (1)

Based on the TLCS results, Nandiyanto has the highest score with 21 citations, followed by Al Husaeni DF with 13 citations, Al Husaeni DN with 12 citations, Biddinika with eight citations and Triawan with eight citations. TLCS is the total calculation of the local citation frequency inside the collection (Barreiro, 2004). Nandiyanto has published five articles in global journals and one global publication. Nandiyanto's most relevant article to the TLCS is "Bibliometric analysis of chemical engineering research using vosviewer and its correlation with the covid-19 pandemic condition," with 12 citations.

Total Global Citation Score (TGCS) is the total score in ISI WoS for all the publications of an author or source (Barreiro, 2004). Positions one and two, Alon and Aprilianti, each have the same number of points, 154 citations, followed by positions 3 to 5, Bahari, Hendradi, and Ismail, with 46 citations each. Alon's article most relevant to TGCS is "A systematic review of international franchising" with 13 citations.

Table 2. List of the ten most productive authors

No	Authors	Recs	TLCS
1	Purnomo	8	2
2	Nandiyanto	6	21
3	Luckyardi	5	5
4	Prahani	5	0
5	Ahmad	4	0
6	Firdaus	4	1
7	Ningrum	4	1
8	Oktafiani	4	0
9	Othman	4	0
10	Suprapto	4	0

Source: Processed in HistCite

In addition, Table 3 describes the ten most productive institutions. The list of the most productive institutions includes the Indonesian University of Education with 18 records, Bina Nusantara University with 16 records, the University of Indonesia with 15 records, Gadjah Mada University with 13 records, and Airlangga University with nine records. 9 (nine) of the top ten institutions are from Indonesia, and one is from Malaysia (Universitas Kebangsaan Malaysia). Journal articles by 88.8% dominated the work published by the Indonesian University of Education.

Meanwhile, Table 4 describes the top 10 productive countries with TLCS and TGCS values. The list of the most productive countries includes Indonesia with 166 records, Malaysia with 24 records, Japan with six records, Italy with five records, and China with five records. Indonesia also dominates the highest TLCS scores with 58 citations and GLCS with 605 citations. Although Norway is not among the top 10 most productive countries, it has the second-highest TGCS score with 156 citations, while Malaysia is third with 103 citations.

Table 3. List of the ten most productive institutions

No	Institutions	Recs	TLCS	TGCS
1	Univ Pendidikan Indonesia	18	31	61
2	Bina Nusantara Univ	16	2	21
3	Univ Indonesia	15	1	30
4	Univ Gadjah Mada	13	1	67
5	Univ Airlangga	9	1	77
6	Univ Padjadjaran	9	1	9
7	Univ Komputer Indonesia	8	10	15
8	Univ Sebelas Maret	7	0	14
9	Inst Teknol Bandung	6	0	9
10	Univ Kebangsaan Malaysia	6	0	14

Source: processed in HistCite

Table 4. List of the ten most productive countries

No	Country	Recs	TLCS	TGCS
1	Indonesia	166	58	605
2	Malaysia	24	1	103
3	Japan	6	0	10
4	Italy	5	1	32
5	Peoples R China	5	1	25
6	Australia	4	1	11
7	Germany	4	0	11
8	Pakistan	4	2	31
9	Saudi Arabia	4	1	14
10	USA	4	0	7

Source: processed in HistCite

3. Science Mapping

After knowing the trends in Indonesian bibliometric research and the productivity of scientific actors, the next step is to map knowledge to discover the most influential knowledge and topics in this field. HistCite software creates historiographical visualizations with the types of LCS graphs and GCS graphs to determine the knowledge base.

Figure 2 illustrates the historiography on a timeline from 2001-2022 based on the LCS graph. The timeline starts with Hartinah's work in 2001 (node 7). This work shows Indonesia's first globally indexed bibliometric research on nutrition (health science). This was followed by Perez's work (node 8), which appeared in 2004 and discussed research on forestry management in Indonesia. However, these two works are not indicated as a theoretical basis in Indonesian

bibliometric research because neither cites them in this graph. A decade later, Almahendra's work was published in 2015. Almahendra's work marks the start of an intermediate phase in the research timeline in this field. In addition, he was the first to use bibliometrics to gain a more comprehensive understanding of various management studies.

Prasojo (node 27) and Saputra (node 98) created the two co-citation links. Two different works from Darmadji in 2018 on the publication productivity of Islamic tertiary institutions (node 15) and the productivity of top universities in Indonesia (node 19) are cited by Prasojo. Then, two of Nandiyanto's works on the publication of chemistry and materials science in Indonesian universities (node 40) and bibliometric analysis of chemical research during the Covid-19 pandemic (node 82) were cited by Saputra.

The LCS group shows more relationships between works. The study by Mesquita et al. showed The LCS graph has more relations between works than the GCS graphs (Mesquita et al., 2017). The work of Nandiyanto (node 40) is an authority article and is used by other research as a theoretical basis in research on publications of chemistry and materials in universities. Another work of Nandiyanto (node 82) in this graphical relations is the hub or connection articles, connecting them to more recent studies.
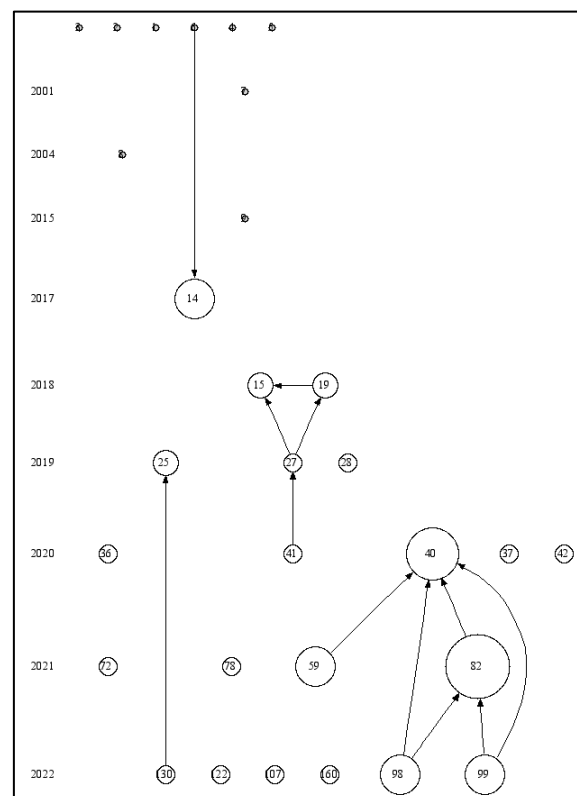

Figure 2. Historiography of bibliometric research in Indonesia based on LCS graph
Source: processed in HistCite

The graph that is made next is the GCS graph type. This graph contains all vertices (works) that have a GCS of 3 or higher. Arrows pointing from one node to the next, suggesting the earlier published work, indicate the citation relationship between articles. The most influential article on GCS graphs is "Bibliometric analysis of absorptive capacity" from Apriliyanti in 2017 with GCS 141. The GCS graph also shows the network's overall density, which is not compact enough like the LCS graph.

The GCS graph forms four large cited groups, including group 1 (the largest), labelled Chemical science and has 6 document members. Group 2 is labelled Bibliometric analysis and literature review and has three members. Group 3 is labelled Food Safety and has three members; Group 4, Top Indonesia Universities, also has three members. The GCS groups present a singular citation relation. Mesquita et al. said that their study showed that two cited groups, the GCS groups, also presented a singular citation relation (Mesquita et al., 2017).

Figure 3 shows a word cloud of the 60 most used keywords. The word Bibliometric ranks first used 100 times, followed by Analysis 86 times, Research 65 times, Review 35 times, Literature 18 times, Trends 17 times, and Mapping 16 times. Several technical terms are found in the word cloud, including Computational, Data, Chain, Network, Model, System, Chemical, Database, Technology, and Energy. These technical terms relate to specific titles or topics studied in bibliometric research in Indonesia.

Figure 3. Word cloud of 60 most used keywords
Source: processed in HistCite

5. CONCLUSION

This study provides the results of an in-depth study of bibliometric research in Indonesia over the last two decades using bibliographic data from the WoS database. The study results show that relevant articles have been published and globally indexed in this field within two decades. The articles were then analyzed using bibliometric techniques: study growth, performance analysis, and science mapping. The performance analysis results show that bibliometric publications in Indonesia continue to increase. The most popular categories studied with bibliometrics are

environmental science and engineering. The results also show the productivity of each scientific actor, including authors, institutions, and countries.

Furthermore, the results of science mapping produce a visualization of two types of historiographical graphs (LCS and GCS) from the HistCite software. This visualization illustrates that the overall density of the network is not compact enough, with only two or three cited groups. These results also suggest four major clusters in bibliometric research in Indonesia: the chemical science cluster, Bibliometric analysis and literature review, food safety, and top Indonesian universities.

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