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## Bibliometric Analysis of Research Development on the Topic of State Border Development Using VosViewer

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**Abstract**— The development of national borders is a priority for a country in the interest of sovereignty and prosperity for its citizens. This study examines the development of research that takes the topic of developing national borders. The research aims to discover the development of the number of publications and maps of the development of publications over the last ten years on the topic of development in question. This research method uses descriptive bibliometric analysis, with metadata from 982 research publications sourced and processed from Google Scholar. The results showed that in the period 2012-2022, there was an increase in the development of publications, from 20 publications in 2012 (2.04%) to 182 publications in 2020 (18.54%), or an increase of 8 times compared to publications with the same topic in 2012. The development of mapping research publications based on keywords (co-occurrence) identified a description of the network of relationships between conceptions of national border development and related topics grouped into 10 clusters. Development is the main issue discussed in various studies in the last ten years. From the visualization overlay on co-occurrence, the keyword 'Development' is the most discussed topic and highlights the need for strengthening and improvement in managing national borders. This research also obtained several topics still open for researchers to develop, including infrastructure development and loci in border areas, which are interesting for future research topics.

**Keywords**—Bibliometric analysis; construction of state borders; border area.

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### I. INTRODUCTION

National borders are significant for the security and order of the country [1]–[4]. In addition, the role and position of the state border have always been a strategic issue for a country. For this reason, the government prioritizes border development in many countries because it relates to state sovereignty and the welfare of its citizens living in border areas. Indonesia has direct relations with three neighboring countries on land, namely Malaysia, Timor Leste, and Papua New Guinea, as well as maritime borders with ten countries: India, Thailand, Vietnam, Singapore, the Philippines, Palau, and Australia, with a coast length of approximately 99,000 km. Most of the border areas of the Republic of Indonesia still face problems of poverty and underdevelopment, with characteristics of being rural, remote, and disconnected from essential services and government. This is generally related to limited connectivity and basic service infrastructure.

To overcome this, in the last decade, Indonesia has become one of the countries that have made significant commitments and changes to developing national borders. The seriousness of the government is shown by the issuance of Law 43 of 2008 concerning State Territories, which mandates not only the management of state borders but also the management of border areas up to the formation of an organization tasked with coordinating the management of state borders, namely the National Border Management Agency. Management of State Boundaries and State Border Areas, which was previously carried out partially in the form of development using a sectoral silo-silo model by each Ministry/Agency and Regional Government, has begun to be integrated by BNPP in an integrated manner starting from planning, coordinating implementation, and evaluate its effectiveness [5].

The development of state borders carried out through the Management of State Boundaries and State Border Areas is a reflection of the state's presence in realizing social justice for all Indonesian people in the spirit of state sovereignty, with

the country's border areas as the front porch and international liaison [6]. Management of State Boundaries and State Border Areas consists of two dimensions, namely: the development of state boundaries (cross-border state, land boundaries, and sea-air boundaries) and the development of border areas (connectivity, basic social, and governance) [7].

To obtain an overview as well as an understanding of the development of state borders from an academic perspective, one of them can be acquired from a literature review and the results of previous scientific research. For this reason, bibliometric analysis is used to track, evaluate, and map topics from domestic and international journals to develop new fields of science. This article examines the development in the country's border regions with bibliometric analysis.

According to Iqbal et al. [8] and Sánchez et al. [9], bibliometric analysis has a function in evaluating scientific research results, mapping scientific domains, and tracing the evolution of new information in a particular field. Bibliometric indicators are calculated over time using two approaches: the number of publications, which measures productivity, and the number of citations, which measures the impact of the resulting articles [9], [10]. The introduction of bibliometrics and scientometrics is carried out by Pritchard [11] with techniques that apply mathematics and statistics to books and other forms of communication media. According to Nalimov and Mulchenko [12], scientometrics is a qualitative method that analyzes science as an information process.

Bibliometrics is a collection of mathematical and statistical techniques to assess the number and quality of books, papers, and publications. In bibliometric network analysis, mapping and grouping approaches are often used. However, mapping and grouping algorithms usually rely on different concepts and assumptions. An integrated approach to mapping and clustering bibliometric networks suggests that mapping methods with VOSviewer and weighted and parameterized variation of modularity-based clustering derive from the same basic premise [13], [14]. This method results in a combined mapping and grouping of the most frequently cited publications for a given period.

Therefore, this study maps the development of research on the development of state borders in the last ten years, both related to the number of domestic and foreign publications, as well as the trend of the development of scientific conceptions based on topics related to the keywords of state border development raised in Scopus indexed publications in the 2012-2022 period.

Bibliometrics refers to using mathematical and statistical techniques for books and other forms of scientific communication [15]. In comparison, Zakaria et al. [16] show that bibliometric analysis can be applied to specific themes, fields, and research difficulties using bibliometric components such as author, year of publication, journal, title, keywords, abstract, citation, index, shared citation, and so on. In simple terms, bibliometrics can explain the process of written communication and its evolution in the scientific field [15], [16].

There are three bibliometric components, namely: a) bibliometrics for bibliometrics, which is the primary domain of bibliometric research and is traditionally used as a research methodology; b) bibliometrics for scientific disciplines

(scientific information), researchers are generally scientifically oriented and have a strong interest in a particular area of specialization, which allows for quantitative research in the search for information; and c) bibliometrics for scientific policy for research evaluation of various research topics [17].

Bibliometric analysis is a quantitative technique for assessing bibliographic information in articles and journals. This study is usually used to investigate references to scientific papers referenced in journals, map the scientific field of journals, and classify scientific articles based on research areas. This technique is applied to sociology, humanities, communication, marketing, and other social science groups. In bibliometric analysis, citation analysis methods determine whether or not two or more different articles cite an article.

The document's scientific concept can be seen through the co-words used. Co-word analysis relies on the analysis of the co-occurrence of words or keywords in two or more documents to index documents [18]. Using non-standard keywords can result in non-uniform terminology, which can be overcome using a thesaurus to normalize it. A thesaurus is a dictionary of terminology that covers certain fields to make the terms used more specific, as well as different from the list of subject headings that are usually general. The purpose of indexing with descriptors is meant to represent a single concept. The purpose of using keyword standardization with a thesaurus is to ensure that a term used for a concept in multiple texts has the same meaning.

VOSviewer stands for visualization of similarities. The algorithm of this program is similar to Multi-Dimensional Scaling (MDS) and is supported by four types of bibliographic database files: Web of Science, Scopus, Dimensions, and PubMed. VOSviewer is software used to build and visualize bibliometric networks. Such networks can be individual journals, researchers, publications, and publication documents based on citations, bibliographic aggregations, co-citations, or co-authoring ties.

The program has text-mining capabilities that can be used to build and describe networks that have repeated occurrences of specific important phrases extracted from scientific literature. One of the advantages of this program is its ease and much in demand because it is a common application and is freely available for visualizing and exploring bibliometric knowledge maps.

VOSviewer has an advantage over other analytics applications because it uses text mining functions to find combinations of noun phrases relevant to mapping and an integrated clustering approach to investigate co-citation data and network co-occurrence [19]. While there are other tools for evaluating text units and matrix similarity, VosViewer's visualization capabilities make it stand out. It is easy to access and examine the program's network of bibliometric data, such as the number of citations or the correlation of co-occurrence between critical terms and concepts, due to interactive features and functions [17], [18], [20]. Therefore, this study aims to map the development of research on the development of national borders in the last ten years, considering domestic and international publications. This study also seeks to identify trends in scientific concepts related to keywords

related to the development of national borders, as contained in Scopus-indexed publications from 2012 to 2022.

## II. MATERIAL AND METHODS

Bibliometric analysis is a quantitative method that describes the characteristics of a set of published literature, such as journal articles or conference proceedings [17]. It involves collecting bibliographic data on publications, such as authors, journals, publication years, and citation counts, and using statistical techniques to analyze and interpret the data. Bibliometric analysis can answer various research questions, such as identifying trends within a research field, measuring the impact of a particular publication or author, or comparing the productivity of different research groups [21]. In this research, we applied the Vos viewer tool [22] in three phases: data collection, analysis, and visualization.

### A. Data Collection

In the first phase, a group of keywords is selected to explore valid scientific publications. In this case, the term "root exploit" or "rootkit" is used as the main keyword in the search engine to find all publications about the root exploit. The second phase refines the publications found from the previous phase by using more optimized queries to narrow down the collected material. Some unwanted documents, such as editorials, retracted publications, corrections, and news, are omitted from search results.

### B. Data Analysis

This phase analyzes the findings based on criteria such as influential journals, widely cited articles, research area, productivity, keyword frequency, institution, and author. The analysis in this study used a method with a descriptive bibliometric analysis approach. The data was sourced from domestic and international journal research publications on state border development in 10 years from 2012 to 2022. Data was collected from publications indexed by Scopus through Harzing's Publish or Perish (Windows GUI Edition 2022),

followed by processing metadata using the Mendeley Desktop application, then mapping, grouping, and analyzing with the Visualizing Scientific Landscape or VOSviewer application (version 1.6.18 - 2022). Data was collected from 1,000 domestic and foreign journal publications related to the keyword of state border development. However, this research's primary data source is the Scopus database. The reason for using the Scopus database is that Scopus provides an extensive and logical database and simple search data.

### C. Data Visualization

Finally, data visualization is done using Vosviewer software. The results of this research are presented clearly and concisely, using tables, charts, and graphs to visualize data. VOSviewer is software that can be utilized to visualize and analyze bibliometric data, and it is a mapping and visualization tool that creates interactive network maps based on bibliographic data. VOSviewer allows researchers to generate network maps based on bibliographic data fields, such as authors, journals, and keywords. VOSviewer lets the researchers customize the network map's appearance and create high-quality visualizations of the results.

## III. RESULTS AND DISCUSSION

### A. Publication Development

Based on the publication on Scopus obtained from Publish or Perish, datasets are saved in RIS (Research Information Systems) format as metadata studied using the VOSviewer application by selecting the option 'data build a map based on bibliographic data.' The approach used to calculate the data set is a complete calculation on the research topic, namely the construction of the nation's border (Figure 1). From a search of 1,000 domestic and foreign journal publications related to the keyword of state border development, data processing was carried out with the results obtained from 997 related journal publications and continued with an analysis of 982 papers published in the last ten years (15 papers not identified publication year).

Cites	Per year	Rank	Authors	Title	Year
11	11.00	20	S. Diggon	The Marine Plan Partnership for the North Pacific Coast – MaPP: A collaborative and co-led marine planning process in...	2022
4	4.00	56	F. Rezazade	A holistic approach to food fraud vulnerability assessment	2022
2	2.00	86	L. Kubalíková	Geodiversity Action Plans as a Tool for Developing Sustainable Tourism and Environmental Education	2022
2	2.00	87	H.T. Andersen	Towards political cohesion in metropolitan areas: an overview of governance models	2022
2	2.00	88	H.A. Lee	Design of a Vaccine Passport Validation System Using Blockchain-based Architecture: Development Study	2022
2	2.00	91	L. Sleuwaegen	Who purchases cross-border? Individual and country level determinants of the decision to purchase cross-border in the...	2022
1	1.00	114	A. Tanina	The Tourist and Recreational Potential of Cross-Border Regions of Russia and Kazakhstan during the COVID-19 Pandem...	2022
1	1.00	115	A. Vorona	Peculiarities of international postal items logistics	2022
1	1.00	116	D. Shankar	A Slippery Sovereignty: International Law and the Development of British Cochin	2022
1	1.00	117	A.C. Díaz-Osorio	How effective are marine parks in protecting their coral reef ecosystem? A study case in the Mexican Caribbean	2022
1	1.00	118	V. Lamb	The fence 'didn't work': the mundane engagements and material practices of state-led development in China's Danjian...	2022
1	1.00	120	Z. Iqbal	Antecedents and consequences of community-based tourism in border district of Jammu and Kashmir	2022
0	0.00	144	L.V. Mesquita	The enforcement of the European Account Preservation Order in the Portuguese legal system - A dematerialised proce...	2022
0	0.00	145	M. Więckowski	Tourist use of border markers in Poland	2022
0	0.00	146	T. Polhong	Adaptation Strategies to Increase Business Competitiveness in the Digital Era: An Empirical Study of Local Freight Firms ...	2022
0	0.00	147	S. Chakraborty	A FUCOM-MABAC-based integrated approach for performance evaluation of the Indian National Parks	2022

Fig. 1 Search for publications on state border development (2012-2022) with the Publish of Parish application.

The results of research conducted on Scopus-indexed Journal documents through Publish or Perish on state border development in the last ten years (2012-2022) show an increase in interest in publications that discuss state border development. This is indicated by a positive trend until 2020, with a downward trend in the last two years (2021-2022). The growth of publication documents increased significantly from 20 publications in 2012 (2.04%) to 182 publications in 2020 (18.54%), or an increase of 8 times compared to publications on the same topic in 2012. A description of the development of research on State Border Development in the last ten years is presented in Table 1.

TABLE I  
DEVELOPMENT OF RESEARCH ON THE TOPIC OF STATE BORDER DEVELOPMENT IN THE LAST TEN YEARS

Publication Year	Publication Total	Percentage
2012	20	2.04%
2013	20	2.04%
2014	28	2.85%
2015	48	4.89%
2016	66	6.72%
2017	96	9.78%
2018	97	9.88%
2019	105	10.69%
2020	182	18.53%
2021	173	17.62%
2022	147	14.97%
<b>Publication Total</b>	<b>982</b>	

The highest growth was in 2020, with 182 publications (18.53%). The issue of border development became a topic of considerable interest to researchers, but there was a decrease in 2021 (173 publications) and 2022 (147 publications). This condition becomes the next discussion space that is also interesting to discuss. From the study of digital records of publication data on the condition of the COVID-19 pandemic, which globally imposes restrictions on crossings between countries, to the closure of borders between countries, it is assumed to be one of the factors that contributed to the decline in the number of publications. However, this number is still high compared to before 2020, and there will likely be more publications until the end of 2022. Despite the decline in publications in 2022 compared to the previous year, there is still an upward trend by looking at the pattern of publication growth until the end of 2022, as shown in Figure 2 below.

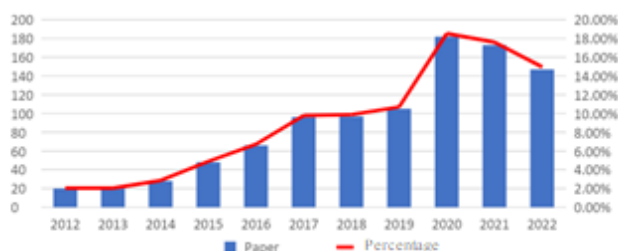


Fig. 2 Research trends on state border development topics (2012-2022)

From a search of research articles with the keyword state border development, 103 publications were conducted in the last 10 or 10.5% of the 982 total metadata of research publications reviewed. Based on available publication data,

the author also presents various countries that contributed to this research. Of the 103 publications, several contributing countries are America, Asia, Europe, and Africa. There are 165 contributing countries. For more details, the following data are presented.

TABLE II  
THE NUMBER OF PUBLICATIONS AND AUTHORS BY DIFFERENT CONTINENTS

Continent	Publication Total	Percentage (%)
<b>USA</b>	53	32
Asia	32	19
<b>Europe</b>	45	27
Africa	35	21
<b>Publication Total</b>	<b>165</b>	

Based on Table 2, information was obtained about the contributions from various continents in this study. The Americas made the most outstanding contribution with a significant amount of research. Countries of the American continent actively participated in the survey, indicating high interest and attention to the topic under study. Furthermore, European countries also made considerable contributions to this study, demonstrating the existence of cooperation and collaboration among institutions and researchers in Europe. In this context, the study reflects the existence of transcontinental engagements, primarily focusing on the Americas and Europe.

On the other hand, the African and Asian continents also made significant contributions to this study. Although the number of studies from these two continents may not be as numerous as America and Europe, their presence in these studies indicates the importance and relevance of the topics studied in the region. Contributions from the African and Asian continents provided diverse and valuable insights to the study, given the geographical, social, and cultural differences between the two continents. Therefore, this study enriches understanding of the topic under study by including the African and Asian continents in its analysis.

### B. Publication Progress Map Based on Keywords

Based on keywords (co-words), using the Scopus database through Publish or Perish, a publication map of state border development in the last ten years (2012-2022) with 10 clusters, as shown in Figure 3. The picture is a network (network visualization), and the relationship between one term and another is related to the co-word of state border development, which was raised in 2012-2022.

Bibliometric analysis is carried out through network visualization, overlay visualization, and density visualization to determine bibliometric networks between research publications based on metadata obtained from Publish or Perish. The bibliometric network consists of circular nodes representing keywords (co-words), and the network's ends or nodes point to relationships representing relationships between pairs of nodes. Mapping and grouping in bibliometric analysis using the Vosviewer program. This mapping is used to understand bibliometric network structures comprehensively.





(18.54%), or an increase of 8 times compared to publications on the same topic in 2012. Based on the results of mapping and grouping from bibliometric analysis of publications indexed by Scopus in the period 2012 to 2022, mapping was obtained (using network visualization) in the form of a representation of co-occurrence networks, namely relationships and interactions between keywords (co-words) on the topic of State Border Development, as well as grouping them in 10 Clusters.

The issue discussed in various studies in the last ten years from overlay visualization on co-occurrence and keywords about State Border Development is discussed. It highlights the need for strengthening and improvement in state border management. This is reinforced by the high level of node saturation shown in density visualization. From density visualization mapping, there are topics in groups with nodes with low intensity or more tenuous, and these topics are still wide open for future research.

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