

Research on Microplastics (MPs) in Indonesia: Bibliometric Analysis 2011-2022 As Sustainable Marine Environment

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Abstract—Microplastics (MPs) are an issue in both natural and manufactured fisheries. Microplastics research is one of the most rapidly growing areas of study in the world of science to date. This study describes and analyzes the results of microplastic research in Indonesia that were published in the form of scholarly papers between 2011 and 2022 based on the Web of Science (WoS) database's research articles. A bibliometric analysis was conducted to explore research trends regarding microplastics in marine Indonesia. This study used VOSviewer to analyze collaboration networks among authors and institutions, as well as co-occurrence analysis of keywords in three defined periods. A total of 46 papers on research microplastics in Indonesia were identified. The most influential microplastics in marine ecosystem research publications are Marine Pollution Bulletin, Chemosphere, Environmental Science and Pollution Research, Water, Air, and Soil Pollution, and Environmental Technology Innovation. The valuable results obtained from this study can help scholars better understand the research development trends and research hotspots in the field of microplastic pollution in the marine ecosystem and provide direction for future research.

Keywords—Bibliometric, Indonesia, Microplastics, and Research

I. INTRODUCTION

Plastics have provided various benefits to modern living due to its low cost, lightweight, and durability, leading in a significant rise in demand. The worldwide industrial sector generates millions of tons of plastic annually, and more than eight million metric tons of plastic end up in the ocean. Plastic contamination is already widespread in the marine environment. The weight of plastics in the ocean is expected to surpass that of fish by 2050 [1]. Plastics are classified into four groups based on their size: macroplastics (> 25 mm), mesoplastics (5–25 mm), microplastics (5 mm), and nanoplastics (100 nm) [2]. Microplastics (MPs) are microscopic plastics resulting from the fragmentation of larger plastics with various morphologies, including foils, foams, fibers, pellets, bits, and microbeads [3–4]. Microplastics can cause marine environmental degradation (MPs).

Global concern has been raised over the presence and build-up of microplastics (MPs) in marine ecosystems. Microplastics can bind to other pollutants by pore filling, hydrophobic interaction,

and hydrogen bonding, which implies that once organisms inadvertently ingest it, it will be more harmful and poisonous and may cause growth suppression, neurotoxicity, digestive blockage, and internal damage to biota [5]. In addition, a number of studies [6-7] have indicated that marine MPs may be ingested by humans through the ingestion of MPs-contaminated seafood, posing a grave concern to human health. Bibliometric analysis is a generally accepted way for evaluating certain themes from a global standpoint. Using statistical analysis tools such as VOSviewer, [8] this method has been utilized in recent years to visualize the advancement of MP research. To the authors' knowledge, however, there have been no early investigations employing bibliometric analysis to analyze global trends in research on microplastics in marine environments. In this study, bibliometric analysis was utilized to examine research trends on microplastics in Indonesia's maritime environment between 2011 and 2022. In order to obtain a comprehensive grasp of this research topic, this study used social network analysis to evaluate research performance trends. In addition, bibliometric analysis is performed to identify science mapping, which comprises a comprehensive evaluation of microplastic Indonesia-related works and hot topics.

II. METHODS

2.1. Data sources and search strategy

Scholars utilize bibliometric analysis as a potent technique for capturing the research performance and growth trends of the global scientific literature. It provides a complete overview of the influential academic literature in a certain discipline or on a particular subject in terms of prominent writers, journals, organizations, and nations. This research selected Thomson Reuters' Web of Science (WoS) database as its scientific data source for bibliometric analysis [9]. WoS has a more standardized method for keeping track of the global scientific literature in a variety of research and study domains.

Eleven years of linked papers on microplastics in Indonesia were retrieved from the WoS Core collection database using the advanced search tool. Included in the search phrases were the article's title, abstract, and keywords: ("microplastic" OR "marine" OR "Microplastic Indonesia") [10]. To eliminate bias caused by the database's daily updating, the search for required articles was performed on a single day. Additionally, only English-language publications were selected for this study's final cut. During the period 2011–2022, the primary research tasks for this study will be identified. 46 articles from a file containing "Full Record and Cited References" were downloaded using the "save for other file formats" export feature with "Tab-delimited (window)" and analyzed using the VOSviewer application. All of the primary data sources used for bibliometric analysis in this paper were listed above.

2.2. Statical analysis

This study evaluates the impact of microplastics on the marine environment before evaluating the performance of the top five scientific publications and their respective universities. The Hirsch index (h-index) indicates that the author or publication has published h works that have been cited h times or more. It is an author-level index that assesses both the citation impact and publication output of a researcher.

The co-authorship analysis in this work was conducted using the user-friendly VOSviewer software (created by Leiden University, Netherlands). It evaluated the dynamic patterns between focus and relationships among the most productive authors and institutions based on the subject under investigation. Each network map reveals that the thickness of the lines connecting nodes is

proportional to their "link strength." In addition, it demonstrates the strength of network linkages and cooperation.

Thirdly, a co-occurrence analysis was undertaken to investigate the comprehensive link between the keywords in the papers they co-authored. The VOSviewer application facilitates network visualization study and scientific mapping in a cluster format. Cluster analysis is performed to discover the primary cluster of microplastic research trends in the marine environment. Author keyword co-occurrence analysis also enables this study to construct and visualize the relationships between the various research networks.

III. RESULTS AND DISCUSSION

3.1. Number of published articles

3.1.1. Publication output by Journals

Figure 1 displays the 46 selected papers of microplastic Indonesia between 2011 and 2022. According to the WoS database search, microplastics research in Indonesia remains insufficient. In the first five years (2011-2015), there were no microplastic-related studies. Following that (2016-2018), there was just one publishing per year. The graph depicts a large peak in the last three years (2019-2021), while 2022 implies that the research is ongoing.

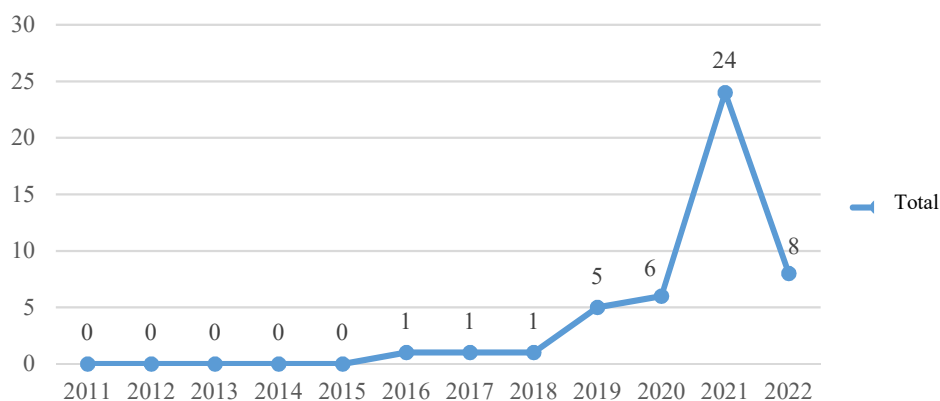


FIGURE 1. PUBLICATION DISTRIBUTION OF MICROPLASTIC IN INDONESIA FROM 2011-2022

3.1.2. Number of Articles Published and Most Cited Research Article

Table 1 displays the five publications that have published the most articles about microplastics in Indonesia's maritime environment during the past eleven years. The topic Marine Pollution Bulletin (534 citations, 16 publications) was the most prevalent across all journals. Also the second most cited is Chemosphere (107 citations, four publications).

TABEL 1. MOST CITED JOURNALS

Journal	Publisher	Citations	Articles	Total Link Strength
Marine Pollution Bulletin	Elsevier	536	16	451
Chemosphere	Elsevier	107	4	175
Environmental Technology Innovation	Elsevier	13	2	74
Environmental Science and Pollution Research	Springer Nature	8	3	128
Water Air and Soil Pollution	Springer Nature	2	3	114

3.2. The Publishing Performance of Authors and Affiliations

According to the findings, 206 authors contributed to the research on microplastics in the marine environment of Indonesia. In Table 2. only five writers were picked, Cordova Muhammad Reza (175 citations, 11 papers) the most mentioned and followed by Riani Etty, Muhammad Fuad, Hadiyanto, and Khoironi Adiani. And Indonesia university with the highest citation numbers in research on microplastic Indonesia is the Indonesian Institute of Sciences (178 citations, nine articles), followed by the Bogor Agricultural University, Institute Technology Sepuluh Nopember, and Dian Muswantoro University. All of the writers are Indonesian and are still engaged in multidisciplinary and transdisciplinary microplastics research in Indonesia.

TABEL 2. INDONESIAN AUTHORS RANKED BY THE NUMBER OF CITATION

Author	Citations	Articles	Total Link Strength
Cordova, Muhammad Reza	175	11	34
Riani, Etty	41	6	26
Muhammad, Fuad	37	4	21
Hadiyanto, Hadiyanto	12	5	23
Khoironi, Adiani	6	5	23

TABEL 3. INDONESIAN UNIVERSITIES RANKED BY THE NUMBER OF CITATION

Affiliation	Citations	Articles	Total Link Strength
Indonesian Institute of Sciences	178	9	1163
Bogor Agricultural University	131	4	1011
Institute Technology Sepuluh Nopember	46	4	242
Diponegoro University	41	6	438
Dian Muswantoro University	6	4	322

3.3. The Research Hotspots and Emerging Trends Based on Keyword Co-occurrence Analysis

Keywords are essential for detecting research gaps and setting study patterns and focus. Keywords that appear frequently indicate hotspots for research. Keyword co-occurrence analysis was performed to find systematic links between various themes across three time periods [11]. The research topic's conceptual evolution can be followed through clusters of keyword nodes, as shown by the keyword analysis. Figure 2 depicts the result, there are four color-coded clusters observed. Cluster 1 (red) is concerned with the prevalence, accumulation, and pollution of microplastics in the ocean and their habitats. Cluster 2 (green) illustrates the connection between microplastics and marine organisms in several waters. Cluster 3 (blue) represents the toxicity of microplastics, while Cluster 4 (yellow) represents the fate of microplastics in a variety of environmental media, such as the marine environment, sediment, and surface water, among others [12]. The larger the network a keyword has, the broader its links [13]. Thus, microplastic is the keyword that appears most frequently in the selected articles, indicating that Indonesia is the second-largest node after microplastic. It supported statements that the majority of microplastic is largely land-based plastic that has poured into the Indonesian ocean, resulting in an abundance of marine water and marine life.

insightful information that Indonesian scholars and practitioners can use as references, by conducting content analysis.

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