Mapping the Landscape of *Durio zibethinus* Research: A Bibliometric Analysis of Southeast Asia's Scientific Output

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Abstract

This study presents the first bibliometric analysis mapping the landscape of durian research in Southeast Asia (SEA). Using the Scopus database, 717 publications worldwide were identified from 2004 to 2024. SEA accounted for 89.8% of the total output, with Indonesia, Malaysia, and Thailand as the top contributors. Original research articles dominated (75%), primarily within Agricultural and Biological Sciences. Thailand's funding agencies were the most prominent, reflecting its status as the world's leading exporter. Universiti Putra Malaysia was the top-contributing institution, while Sirikantaramas, S. (Chulalongkorn University, Thailand), was the most prolific author. Keyword analysis confirmed *Durio zibethinus* as the primary research focus. The findings underscore a strong correlation between national research investment, scientific output, and economic leadership in the durian industry. This study provides a foundational roadmap for strengthening research capacity and export capability among SEA cultivators.

Keywords: bibliometric analysis; durian; *Durio zibethinus*; Southeast Asia; research trends

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1. Introduction

Durian, commonly regarded as the "King of Fruits," is produced by several tree species belonging to the genus *Durio* and the family *Bombacaceae* [1]. Of the approximately 30 recognized *Durio* species, at least nine produce edible fruit; however, only one, *Durio zibethinus*, is widely available on the international market [2].

Native to Southeast Asia, global demand for *D. zibethinus* has surged dramatically due to its unique sensory properties and perceived health benefits [1,2]. This rising economic importance is reflected in a significant increase in scientific publications on durian cultivation, biochemistry, and product development. As the fruit's center of origin and primary producer, Southeast Asia (SEA) is logically at the forefront of this research effort [3,4].

While the volume of research is growing, the scientific landscape remains fragmented. Existing literature provides deep insights into specific areas such as the fruit's volatile compounds responsible for its pungent aroma [5], its rich nutrient profile [6,7], or postharvest technologies [8] but a comprehensive, quantitative synthesis of the entire field is lacking.

Pertinent questions remain unanswered: What are the overarching trends and evolution of *D. zibethinus* research? Which institutions, countries, and funding bodies are leading this effort? What are the predominant research themes and emerging niches? Most importantly, as the primary stakeholder, how has Southeast Asia's scientific contribution shaped the global understanding of this fruit? The absence of a bibliometric analysis represents a critical gap, leaving policymakers, researchers, and industry stakeholders without a clear roadmap of the field's strengths and weaknesses.

To address this gap, this study employs bibliometric analysis to quantitatively map the developmental trajectory of *D. zibethinus* research, with a specific focus on the contribution of Southeast Asia. Using data from the Scopus database from 2004 to 2024, this work aims to quantify the volume and growth trajectory of *D. zibethinus*-related publications; identify the most influential countries, institutions, authors, and funding agencies; visualize the conceptual structure of the field through co-word and thematic analyses to pinpoint established and emerging research fronts; and critically assess the role and collaboration patterns of Southeast Asian nations in driving innovation.

By providing this first overview, this analysis offers an evidence-based foundation for strategic research planning, fostering future international collaboration, and guiding investment decisions to strengthen SEA's position in the global durian value chain.

2. Methodology

2.1 Data Source and Search Strategy

A comprehensive bibliometric analysis was conducted using the Scopus database, which was selected for its extensive coverage of more than 26,000 indexed journals across all scientific fields, exceeding that of Web of Science [9]. Scopus is a robust resource that incorporates Medline data and is used by major ranking systems such as the QS World University Rankings and Times Higher Education [9,10]. Furthermore, its rigorous selection process helps ensure the indexing of high-quality journals with effective peer-review systems and strong editorial standards [11].

The literature search was conducted on October 23, 2024. The search query (TITLE-ABS-KEY (durian OR *durio* AND *zibethinus*)) was used to retrieve documents from article titles, abstracts, and keywords. The publication year was restricted using the filter PUBYEAR > 2003 AND PUBYEAR < 2025 to capture all relevant documents indexed between January 1, 2004, and October 23, 2024.

2.2 Inclusion and Exclusion Criteria

The study included all English-language document types (e.g., articles, reviews, and conference papers). Documents with authors affiliated with multiple Southeast Asian countries were counted for each contributing nation. Documents not related to the genus *Durio* and the species *zibethinus*, or those that did not meet the inclusion criteria, were excluded.

2.3 Data Extraction and Validation

The search results were refined within the Scopus database, and the complete dataset was exported. To ensure accuracy and relevance, a random sample of 100 documents was manually screened against the inclusion criteria to exclude any misleading records. The final validated dataset was exported in comma-separated values (CSV) format for analysis.

The exported data included the following fields: title, authors, affiliations, publication year, source title, citation count, keywords, abstract, document type, subject area, and funding sponsors.

2.4 Data Analysis

The exported data were imported into Microsoft Excel for cleaning and descriptive statistical analyses to summarize publication trends, leading countries and institutions, active journals, and key subject areas.

For network visualization, the data were imported into VOSviewer (version 1.6.20). This software was used to construct and visualize bibliometric networks based on co-authorship (among countries and authors) and co-occurrence (of keywords) to map the intellectual structure of *D. zibethinus* research.

3. Results and Discussion

3.1 Publication Volume and Geographical Distribution

A total of 717 documents related to *D. zibethinus* were identified in the Scopus database between January 1, 2004, and October 23, 2024. The vast majority of this research output (89.8%, n = 644) originated from Southeast Asia (SEA), underscoring the region's dominant role in durian science (Figure 1).

Within SEA, the distribution of publications among the major durian-cultivating nations was relatively close: Indonesia (30.9%, n = 199), Malaysia (30.3%, n = 195), and Thailand (27.2%, n = 175) were the top three contributors, collectively accounting for 88.4% of the total output. The Philippines contributed 4.3% (n = 28). In contrast, Cambodia and Laos recorded only one publication each, while Timor-Leste had none.

The prominence of Indonesia, Malaysia, and Thailand in publication output aligns with their status as major cultivators and their established agricultural research capacities. The near parity between Indonesia and Malaysia suggests a strong institutional focus on durian research in both countries.

The minimal output from Cambodia, Laos, and Timor-Leste likely reflects two interrelated factors: lower national research capacity and the limited economic significance of durian in these countries, which reduces incentives for targeted research investment. This disparity highlights a potential research development gap that could hinder future economic utilization of durian in these regions.

3.2 Document Types, Citations, and Funding Landscape

The 717 documents garnered a total of 12,924 citations, averaging 646 citations per year. Original research articles constituted the vast majority of document types (83.5%, n = 538), while correspondence contributed the least (0.31%, n = 2).

Analysis of funding sponsors revealed substantial national investment. Malaysia's Ministry of Higher Education was the top individual funding agency (n = 34 sponsored documents). However, a broader examination of the top 10 funding agencies (Table 1) indicates Thailand's stronger collective investment: five Thailand-based agencies sponsored 81 documents, compared with 55 sponsored by three Malaysian agencies and 9 sponsored by one Indonesian agency.

The relationship between national funding and research output is clearly evident. Thailand's robust funding infrastructure, reflected in the high number of sponsored publications among the top agencies, mirrors its dominant position in the global durian economy. As the world's leading exporter, supplying approximately 94% of global durian exports, Thailand's research investment appears strategically aligned with its economic interests [12]. The country's large annual production (exceeding 600,000 tons) and export revenue (USD 3.3 billion in 2022) are likely both a driver and a beneficiary of its substantial research output [12]. Overall, these patterns suggest that economic performance, research productivity, and export growth are closely interconnected.

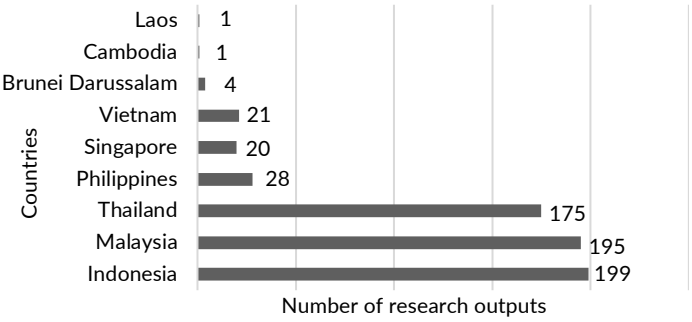

Figure 1: *D. zibethinus* research outputs in Southeast Asia between 2004 and 2024.

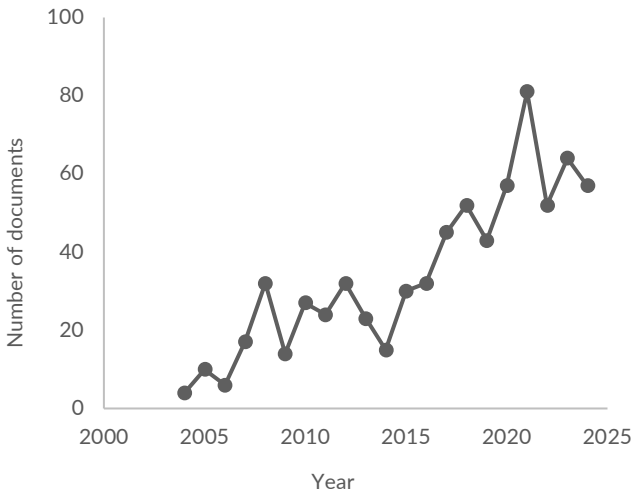

Figure 2: Number of durian-related documents published in SEA between 2004 and 2024.

3.3 Temporal Trends in Publication Output

Analysis of annual publication counts showed a general upward trend, culminating in a peak of 81 documents in 2021, followed by a notable decline in subsequent years (Figure 2). The peak in research output in 2021 coincides with two major global developments. First, it aligns with reported peak global durian export figures, which reached 930,000 metric tons that year [12]. This suggests that commercial interest and economic activity may be key drivers of scientific research priorities.

Second, the timing overlaps with the COVID-19 pandemic, a period during which fruit and vegetable consumption was widely promoted to support immune function and reduce the risk of severe complications [13]. The heightened public and scientific focus on health and immunity during this period may have encouraged additional research on tropical fruits such as durian, which is rich in bioactive compounds. However, more specific evidence is needed to confirm this relationship for durian.

Finally, the 2024 data were retrieved in October, before the year had concluded. This likely contributes to the lower publication count observed for that year.

3.4 Research Focus, Leading Institutions, and Active Researchers

3.4.1 Subject Area Distribution

The distribution of documents by subject area, based on the Scopus classification scheme, is presented in Table 2. More than half of the publications were classified under Agricultural and Biological Sciences. Acta Horticulturae published the highest number of durian-related studies.

3.4.2 Leading Institutions and Researchers

Analysis of institutional contributions showed that the top eight research institutions accounted for a substantial share of the overall output. Universiti Putra Malaysia (n = 68), Universitas Sumatera Utara (n = 32), and Chulalongkorn University (n = 31) were the top three contributors. Notably, Thailand-based institutions collectively produced the highest number of documents among the top eight.

Table 1: Summary of citations, documents and sponsors of durian-related research in SEA.

Citation Metrics	*Total*
Total Documents	717
Citations	12,924
Citation per Year	646.20
Citations per Paper	18.03
Authors per Paper	4.41
h-index	60
g-index	85
Document Type	*Number*
Article	538
Conference Paper	133
Review	23
Book Chapter	7
Erratum	5
Conference Review	4
Note	3
Letter	2
Top 10 Funding Sponsor	*Outputs Funded*
Ministry of Higher Education, Malaysia	34
National Research Council of Thailand	23
Thailand Research Fund	22
Chulalongkorn University, Thailand	17
National Natural Science Foundation of China	12
Universiti Putra Malaysia	12
Kasetsart University Research and Development Institute, Thailand	10
Kasetsart University, Thailand	9
Kementerian Sains, Teknologi dan Inovasi	9
Universitas Sumatera Utara, Indonesia	9

At the author level, Sirikantaramas, S. (Chulalongkorn University, Thailand) was the most prolific researcher with 16 publications, followed by Poovarodom, S. (n = 14) and Mirhosseini, H. (n = 13). Five of the top seven most active authors were affiliated with institutions in Thailand. Additional details are presented in Table 3.

The predominance of publications in Agricultural and Biological Sciences is expected, as this domain encompasses key areas of durian research, including cultivation, physiology, genetics, and postharvest biology, which are essential to understanding and improving the crop.

The leadership of Thai institutions in both institutional output and author productivity reflects the country's strategic investment in durian research, as indicated in the funding analysis (Table 1). This suggests that substantial national funding supports a research environment in which both institutions and individual scientists can produce high volumes of work. Thailand's position as the global export leader provides a strong economic incentive for such investment, reinforcing a cycle in which research supports the industry and industry success, in turn, sustains further research.

The high productivity of authors such as Sirikantaramas, S. also suggests the presence of dedicated, well-supported research groups focusing on durian, which are essential for sustained scientific advancement in this field.

3.5 Keyword Co-Occurrence Analysis

Keyword analysis is critical for research discovery and can reveal the conceptual structure and emerging trends within a scientific field [14]. To map the primary research themes in durian science, a

Table 2: Distribution of durian-related documents according to the Scopus subject areas hierarchical classifications and list of top journals.

Subject Areas	*Number of Documents*
Agricultural and Biological Sciences	388
Environmental Science	151
Biochemistry, Genetics and Molecular Biology	116
Chemistry	93
Engineering	70
Earth and Planetary Sciences	63
Chemical Engineering	54
Medicine	48
Pharmacology, Toxicology and Pharmaceutics	39
Physics and Astronomy	39
Materials Science	37
Energy	36
Social Sciences	28
Multidisciplinary	23
Computer Science	17
Top Journals	*Number of Durian-Related Documents*
Acta Horticulturae	51
IOP Conference Series Earth and Environmental Science	40
Food Chemistry	17
Biodiversitas	16
AIP Conference Proceedings	14
Food Research	11
Scientia Horticulturae	11
Bioresource Technology	9
Postharvest Biology and Technology	9
International Food Research Journal	8

co-occurrence network of keywords was constructed. The most frequent keyword was "*Durio zibethinus*" (375 occurrences). Other high-frequency terms included "durian," "fruits," "chemistry," "human," "Thailand," "plant extract," "flavonoid," "Malaysia," "antioxidant," "antioxidant activity," and "*malvaceae*" (Figures 3A and 3B).

Using a minimum threshold of 20 occurrences per keyword and a full-counting method, 33 keywords met the criteria. These were grouped into five distinct clusters, each representing a major research focus area (Figure 3A). Collectively, these clusters reflect the main interdisciplinary pillars of durian research: Cluster 1 (Agricultural and Biochemical Focus): adsorption, article, *Bombacaceae*, chemistry, controlled study, durian, *Durio*, *Durio zibethinus*, fermentation, fruit, genetics, Malaysia, *malvaceae*, metabolism, non-human, pH, temperature, priority journal; Cluster 2 (Bioactive Compounds and Health): antioxidant, antioxidant activity, antioxidants, *Durio zibethinus* extract, flavonoid, humans, plant extract, unclassified drug; Cluster 3 (Comparative Fruit Studies): fruits, *Garcinia mangostana*, *Nephelium lappaceum*; Cluster 4 (Material Science and Analysis): biomass, Fourier Transform Infrared Spectroscopy; and Cluster 5 (Regional Focus): Thailand.

The dominance of the species name "*Durio zibethinus*" confirms it as the primary focus of scientific inquiry. Furthermore, the cluster structure remained stable when the analysis was repeated using a lower minimum threshold of 10 keyword occurrences by adjusting the resolution parameter.

Table 3: Research institutions and active author.

Research Institutions	*Number of Publications*
Universiti Putra Malaysia	68
Universitas Sumatera Utara	32
Chulalongkorn University	31
IPB University	28
Universiti Sains Malaysia	26
King Mongkut's Institute of Technology Ladkrabang	25
Kasetsart University	24
Prince of Songkla University	17
Active Authors in Durian Research	*Number of Documents (Affiliation/s)*
Sirikantaramas, S.	16 (Center of Excellence in Molecular Crop, Department of Biochemistry, Faculty of Science, Chulalongkorn University, Bangkok, Thailand)
Poovarodom, S.	14 (Faculty of Agricultural Technology, King Mongkut's Institute of Technology, Ladkrabang, Bangkok, Thailand)
Mirhosseini, H.	13 (Department of Food Technology, Faculty of Food Science and Technology, University Putra Malaysia, Serdang, Selangor, 43400 UPM, Malaysia)
Haruenkit, R.	11 (Faculty of Agriculture/Postharvest, Technology Innovation Center, Chiang Mai University, Thailand)
Amid, B.T.	10 (Department of Food Technology, Faculty of Food Science and Technology, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia)
Ketsa, S.	10 (Kasetsart University, Bangkok, Thailand; The Royal Society of Thailand, Bangkok, Thailand)
Pongsamart, S.	10 (Department of Veterinary Pharmacology, Chulalongkorn University, Bangkok 10330, Thailand)

3.6 International Collaboration (Co-Authorship)

To assess global collaboration patterns, a co-authorship analysis was conducted using countries as the unit of analysis. The parameters included fractional counting, association strength normalization, a clustering resolution of 1.00, and a layout algorithm with an attraction value of 2 and a repulsion value of 1. A minimum threshold of five documents and one citation per country was applied. Of the 60 countries identified, 21 met these criteria, forming a collaborative network visualized in four distinct clusters (Figure 3C). Thailand, Malaysia, and Indonesia emerged as the dominant research hubs, as reflected in their high total link strengths of 57, 44, and 30, respectively.

The co-authorship analysis highlights the central role of Southeast Asia in the global durian research landscape. The high link strengths of Thailand, Malaysia, and Indonesia reflect not only their substantial publication output but also their active participation in international collaborations with countries such as the United States, Japan, China, Australia, Israel, and Poland. The four distinct country clusters suggest multiple collaborative networks that may

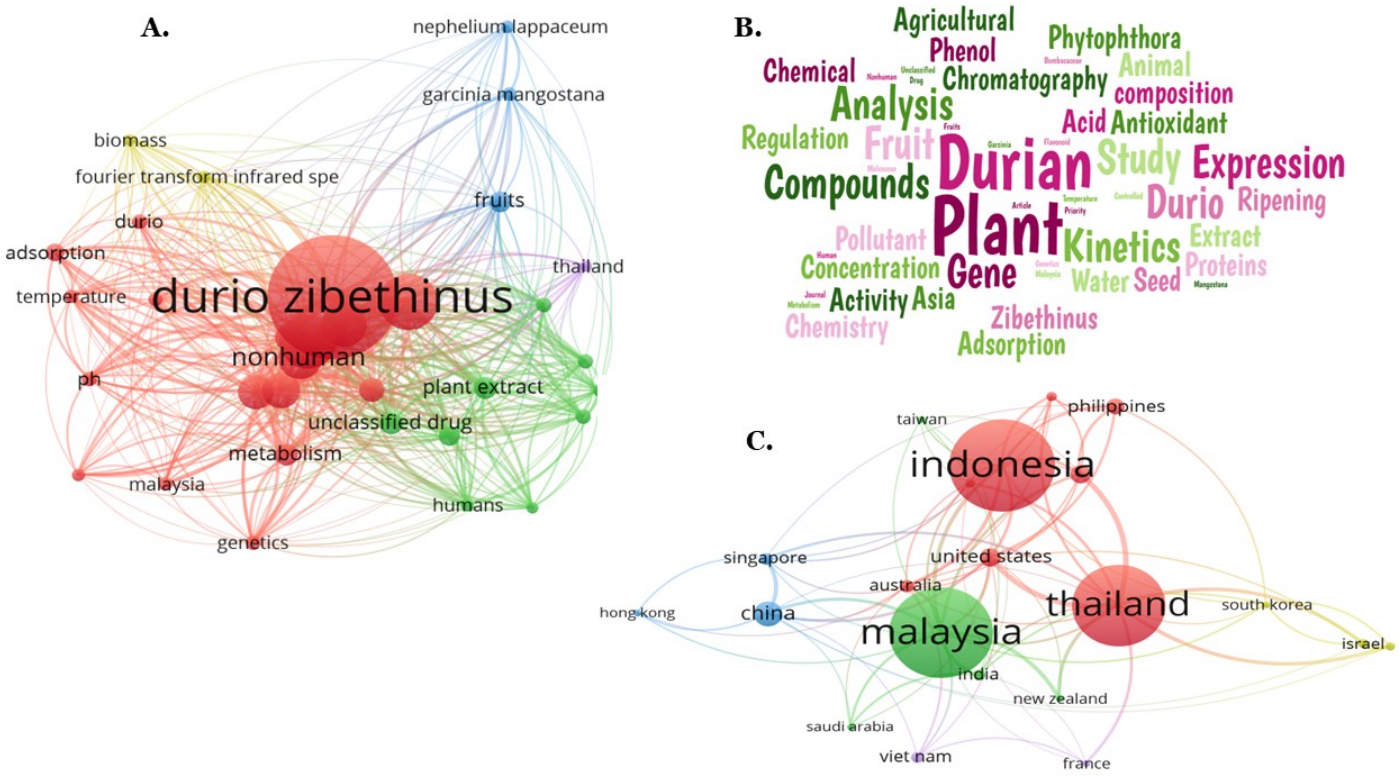

Figure 3: Network visualization map and cloud view. A: Co-occurrence of all keywords. B: Keywords. C: Co-authorship by countries.

be organized around specific research themes or geographic proximity. This high level of international cooperation is crucial for driving innovation and addressing complex challenges in durian cultivation, processing, and utilization.

3.7 Limitations

The articles analyzed in this study were retrieved from the Scopus database and covered publications from January 1, 2004, to October 23, 2024. It is important to note that the 2024 data are partial, as the search was conducted before the end of the year. Although incorporating records from multiple databases (e.g., Web of Science, PubMed, and Google Scholar) could be beneficial, only Scopus was used to avoid data duplication and inconsistencies that can compromise bibliometric analysis [15]. Scopus was selected for its broad coverage, extensive publication records, and strong reputation for data quality [16].

Accordingly, this analysis provides a thorough overview of research on *D. zibethinus* but does not constitute an exhaustive record of all durian-related literature, as it is limited to this primary species. Nonetheless, the Scopus-derived dataset is sufficiently robust to identify major trends, highlight research gaps, and suggest future directions for *D. zibethinus* research.

4. Conclusion

This bibliometric analysis provides the first mapping of global durian research from 2004 to 2024, clearly establishing Southeast Asia (SEA) as the epicenter of the field. The region accounted for nearly 90% of the scientific output, with Indonesia, Malaysia, and Thailand emerging as the dominant contributors. This leadership mirrors their role as the fruit's primary cultivators.

A key finding is the strong correlation among national research investment, scientific output, and economic success. Thailand's position as the most heavily funded country, with the highest number of institutional publications and leading researchers, aligns with its dominance in the global export market. This highlights a strong link between strategic research and development (R&D) investment and commercial capability. For other durian-cultivating nations in SEA, particularly the Philippines, these findings point to a significant opportunity. To enhance export competitiveness and move up the global value chain, increased investment in R&D is essential. A knowledge-driven approach focused on cultivation efficiency, postharvest technology, and product innovation will be critical for future growth.

This study not only outlines the current landscape but also provides a foundational dataset to support policymakers, funders, and researchers in guiding future investment and collaboration in durian research, ultimately fostering a stronger and more innovative global durian industry.

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Conflict of Interest Statement

The authors declare no conflict of interest.

Author Contributions

Both authors have contributed equally. They have read and agreed to the published version of the manuscript.

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