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Research Conception of Palm Leaf Manuscript Conservation: Bibliometric Analysis of Scopus database

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ABSTRACT

The most significant and reliable source for learning about the intellectual output of our predecessors is thought to be manuscripts. The bibliometric analysis is used in the study to conduct a social network analysis of the scientific literature on the conservation and preservation of palm leaf manuscripts. The objectives of the study are to identify the format of palm leaf conservation and preservation research publications, to identify which journals are the most fruitful, to identify the most prolific authors and authorship patterns in studies on palm leaf conservation and preservation, etc. "palm leaf manuscripts", "palm leaf manuscript conservation", and "conservation and preservation" were keywords that were used to search the documents. Biblioshiny package, an open-source Excel package was used to analyse and visualise the data in the study. Out of 101 research publications, the majority (84) of the research output has been published as journal articles. "Sciences and the global on methods, questions, and theory,"written by Sivasundaram S. in 2010, is one of the most globally cited articles in the field of palm leaf conservation and preservation. From 2002 to 2021, the top author in the field of palm leaf preservation and conservation is Draper J. from Thailand, who presented 3 papers and received the highest citation count of 1.67. India is the most productive country in Asia, with 45 publications of palm leaf manuscript conservation documents. The most relevant affiliation was the University of Khon Kaen in Thailand and the most cited country was the United Kingdom. The authors commonly used the word manuscript, digitization, Buddhism, and conservation. The study recommends that conducted from a broader perspective by covering other relevant databases and using other bibliometric software and packages.

KEYWORDS: *Bibliometric analysis, Biblioshiny, Conservation and Preservation, Palm leaf manuscripts, Scopus database*

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1 INTRODUCTION

Collections of palm leaf manuscripts which embody the depth of human knowledge and artistic expression are a valuable source of information about our history and culture. Ancient writings are known as palm leaf manuscripts were inscribed on sheets of palm leaf using a "Panhinda" (metal stylus) (Nishanthi & Wijayasundara 2022). The leaves of a palm tree are incredibly adaptable and can last for more than a thousand years. One of the earliest writing materials was palm leaves, which were utilized in coastal nations of Indonesia, Thailand, Malaysia, Sri Lanka, and India (Agrawal 2006). As of this writing, more than one million palm leaf manuscripts have been discovered globally. The majority of them are preserved in temples, monasteries, national museums, archives and national libraries (Jarusawat et al. 2018; Weerabahu 2019). Others are stored in universities or specialized libraries. Currently, many institutes are paying close attention to scientific methods of palm leaf manuscript preservation, especially digitization, and are trying to develop digital libraries for palm leaf manuscripts. However, even though the majority of information institutions place a strong emphasis on digitization for preservation. But a palm leaf manuscript needs to be physically conserved to perpetuate its life. Indians have tried to make palm leaf manuscripts more durable by using traditional methods (Baquee & Raza 2019). According to the literature, many publications were published related to the digitalization of palm leaf manuscripts. Therefore, researchers from around the world have been motivated to research the digitalization of palm leaf manuscripts. Unprecedented new knowledge was produced as a result, and numerous publishers made their publications on palm-leaf manuscripts, conservation, and preservation freely accessible online. Therefore, bibliometric analyzes of palm leaf manuscript preservation and conservation researches are expected to be conducted globally.

1.1 Review of Literature

The production and preservation of any nation's art, history, and culture rely heavily on manuscripts. One of the earliest types of written documentation, palm leaf manuscripts were used in Southeast Asia to record early recorded information on topics including Buddhism, knowledge of history, traditional law and customs, astrology, magic, mythology and rituals, traditional medicine and healing, grammar and lexicography, as well as poetry, epic stories, and folk tales (Agrawal 2006; Wharton & Hundius 2010). Historical handwritten palm leaf manuscripts are important for those who are interested in learning about historical records. Palm leaf manuscripts relating to art and architecture, mathematics, astronomy, astrology, and medicine dating back several hundreds of years are still available for reference today thanks to many ongoing efforts for the preservation of ancient documents by libraries and universities around the world (Butdisuwan & Babu 2014). Palm leaf manuscripts are one of the vital types of documents containing the indigenous knowledge of Sri Lanka. These manuscripts contain previously unpublished information about Sri Lanka's history and culture. Palm leaf manuscripts are regarded as a priceless cultural treasure, particularly in the Sri Lankan community, and they are useful for study and research in a variety of sectors to aid in the growth of the nation (Nishanthi & Wijayasundara 2022). Palm leaf manuscript conservation has received attention in Sri Lanka as well.

Preservation was the biggest problem palm leaf manuscript keepers ever had. Since the days when palm leaves were produced and used to record information, there have been several ways to preserve that knowledge. Since the beginning of time, people have frequently used plant extracts to halt natural deterioration. Later, new methods of fumigation were combined with chemical treatments. Most importantly, digitization is acknowledged as the greatest technique for maintaining

manuscript content (Udaya Kumar et al. 2009). The steps that follow are intended to stabilize palm leaf manuscripts. There is no attempt made here to address remedial therapy, such as surface cleaning or repair, but some type of fumigation should be carried out before starting stabilizing work. There are three primary stages to the stabilization methods (Dean 1990): The leaves being secured, making the case of the manuscript, and producing the box. After fumigation, the surface of the manuscript should be gently dusted to remove dust and insect parts. With the aid of a cord or string, all of the folios (palm leaves) are bound together. The original ties should be carefully loosened and the folios examined one by one. Whenever possible, folios should be kept in an orderly manner. If the string is broken, a new one with softer fibers and the same thickness as the old one should be used.

However, most of the 10,000 Malay manuscripts that have been verified and identified as having been collected are from the past century or maybe even just fifty years ago. Regardless of their age, the bulk of them are yellowish, have stains, holes, and ink feathering, and are delicate. Additionally, they are often fragile and missing the first or last few pages. Our main concern is with their physical preservation and conservation (Ming 1993). Therefore, it is crucial to keep these manuscripts safe to safeguard them for the future. The preservation of these manuscripts is done using many traditional methods.

1.1.1 Traditional methods used for preserving palm leaf manuscripts

Indigenous methods, as defined by Baquee & Raza (2019), are methods that have been used since very early times. Examples include dusting and cleaning manuscripts, wrapping them in clothing to protect them from dust and insects, storing them outside for sunlight, and using Ajwain powder, Custard Apple Seed, Neem Seed, and Black Cumin to keep harmful insects away.

According to Sahoo & Mohanty (2004), Indians are aware of preservation. Since antiquity, numerous indigenous procedures have been used for the preservation of manuscripts. The main factors that led to the manuscripts being destroyed were light, dust, heat, and humidity were also widely known to the general population. To protect the manuscripts from these potential influences, they were typically covered by clothing. However, the following are some of the traditions that the custodians of manuscript India have had over the years and are still following:

- The manuscripts are preserved in a secure environment even before they are written on the leaf. It is believed that seasoning the leaf by submerging it in mud or boiling it in water will have specific antibacterial characteristics that will protect it from insect damage.
- Usually, holes are bored into the manuscripts' leaves, and cords are then threaded through them to keep them together. These are then sandwiched between two flat, rigid hardwood boards that also have the same kind of cord-passing holes. The hardwood boards squish the leaves from both directions, eliminating chipping and edge curling.
- By being wrapped in clothing, the manuscripts are protected from dust, worms, and to a significant part from changes in ambient humidity and the absorption of acidic gases.
- It is traditional to wrap palm leaves in clothing that is bright red or yellow. Insects are reported to be attracted to the color red, which is also said to be insect-repelling. Additionally, turmeric's yellow hue is thought to have certain germicidal qualities that prevent insects from contacting the manuscripts.
- Manuscripts are wrapped in silk because, despite its long use, it is exceptionally free of bookworms.

- The bundles of manuscripts are also kept in substantial wooden crates to reduce the harsh weather variations.
- Exposing palm leaves in the kitchen is supported by the scientific fact that smoke particles can repel insects. Even if the smoke deposits change the leaves unintentionally, this procedure effectively prevents insect attacks on palm leaf manuscripts.
- When leaves are exposed to the soft rays of the Sun when it rises or sets insect and the growth of microorganisms is halted.
- The palm leaves are commonly arranged and fastened together with a bamboo needle and cotton or silk string to preserve the integrity of the leaves.
- In other instances, manuscript preservation occurs underground
- Manuscripts are often exposed to the Sun during the lunar month of Bhadraba since its rays are so beneficial in August. The worms die in the sunlight as a result of this.
- Palm leaves are removed on Vijay Dashami using an ancient method, cleaned, and then replaced (Sahoo & Mohanty 2004).

Both curative conservation and preventive conservation are possible, according to Borthakur (2021). Curative conservation aims to stop further deterioration of the damaged manuscript, whereas preventative conservation aims to reduce the risk of future decay for both damaged and undamaged manuscripts. Here, a preventive technique of manuscript conservation is explained to shed light on the various steps that can be taken to safeguard priceless manuscripts from deterioration. Causes behind deterioration or decay of manuscripts and its remedial measures. Natural disasters that cause destruction include floods and earthquakes. Biological factors: Grasshoppers, silverfish, flies, and other insects, as well as rodents and microorganisms (viruses, algae, and fungus) (Rats, mice, etc.) (Sageer & Francis 2014). There can be instances of theft and vandalism in a library or museum that protects manuscripts. The following actions were suggested by Borthakur (2021).

- Improper handling of manuscripts
- Improper storing techniques
- Lack of professional training Absence of professional communication between institutions and institutions with similar goals. The following are some common corrective actions taken by curators or conservators:
- Using naphthalene balls, citrus fruit, salt, table salt, lemongrass oil, or neem oil or extract.
- Periodic Manuscript Sunbathing in Shade at Minimum Temperature.
- Periodically exposing the manuscripts to the lowest temperature of the sun.
- Acid-free red cloth wrapping the manuscripts.

Fatima & Fatima (2021) state that to prevent damage to the loss of library materials, preventive conservation comprises creating and implementing the right environmental conditions, handling and maintenance methods, storage procedures, policies, and processes for integrated pests. A method employed in control measures, disaster preparedness, etc. Throughout their life, library materials need preventive conservation. The look of the object is not changed during preventive conservation, hence it can be argued that preventative conservation is a continual process that includes all indirect acts that don't damage the structure and materials of the object being conserved.

However, traditional oil has been used to preserve palm leaf manuscripts in ancient Sri Lanka. They are Vateria copallifera, (Malvales: Dipterocarpaceae) resin oil, or Dummala oil, and Madhuka longifolia seed oil (Ericales: Sapotaceae), also known as Mee oil. This oil is mixed with charcoal powder and applied to

dried folios. This application was made using clean cotton clothes. The charcoal powder is made out of Trema orientalis (Rosales: Cannabaceae) (Gaduba in Sinhala). Apart from this, the palm leaf manuscripts were stored in a box made from the wood of the Neem (Kohomba) tree, which has insect-repellent properties. As a traditional practice in Sri Lanka, manuscripts were often stored in kitchens, and the wood smoke from the stove helped keep insects away from the palm leaf manuscripts. Therefore, there is now increasing interest in using digitization to preserve manuscripts in addition to traditional approaches.

1.1.2 Modern methods used for preserving palm leaf Manuscripts

The manuscripts are the earliest handwritten records that depict the illustrious past of our ancestors. The physical condition of these manuscripts is deteriorating daily due to the quick passage of time and a variety of causes and situations. Many centers, universities, organizations, and institutions are currently making efforts and taking the necessary steps to preserve these priceless manuscripts digitally for the benefit of future generations. It is equally vital to understand digital preservation before discussing manuscript preservation. Here are a few significant and helpful definitions of digital preservation.

According to the Association for Library Collection & Technical Services: A Division of the American Library Association (2007), "digital preservation combines policies, strategies and actions to ensure access to reformatted and born-digital content regardless of the challenges of media failure and technological change. The goal of digital preservation is the accurate rendering of authenticated contents over time." The Encyclopedia of Information Technology defines the term digital preservation as "the process of maintaining in a condition suitable for use, materials produced in digital formats. Problems of physical preservation are compounded by the obsolescence of computer equipment, software, and storage media. Also refers to the practice of digitizing materials originally produced in non-digital formats (print, film, etc.) to prevent permanent loss due to deterioration of the physical medium."

The extension and improvement of information storage and retrieval systems that change text, images, sounds, static or dynamic images are known as digitization. Both preservation and accessibility depend on digitization. In this sense, the only way to share a cultural legacy with communities is through the digitization of manuscripts. The Internet has shown to be the finest method for digitization, and because of the availability of the web, manuscripts may be made available to the public without compromising their safety. Modern methods, as defined by Baquee & Raza (2019), include low temperature, moisture absorbents, microfilming, and Xeroxing manuscripts. One of the most recent methods employed by many institutions and organizations is digitizing manuscripts

At present, many institutions in Sri Lanka have started digitizing. The Faculty of Social Sciences at the University of Kelaniya has started a digital library project to digitize palm leaf manuscripts (Ranasinghe & Ranasinghe, 2013). As they mentioned, they have completed digitizing more than a hundred thousand folios (Ranasinghe & Ranasinghe, 2013). The Sri Jayewardenepura University Library also uses traditional methods of preservation to preserve palm leaf manuscripts in addition to using digital preservation techniques. During digitization, the first step is to scan folios one by one. The digital library of palm leaf manuscripts was developed using DSpace open-source software, which included the creation of a database. It links to Scholar Bank, the library's digital repository. Metadata for palm leaf manuscripts was initially entered into the database along with bibliographic information. Once the database is complete, the bibliographic information will be linked to the library's Online Public Access Catalog

(OPAC). Users interested in learning more about these manuscripts can access the bibliography of palm leaf manuscripts through OPAC (Nishanthi & Wijayasundara 2022).

As a benefit of information technology, digital preservation makes content more accessible to people all over the world through the various channels that are readily available to us today. The bibliometric analysis provides a transparent, organized, and reproducible review method, which significantly improves the quality of the literature review. It gives a way to map research areas and significant publications without subjectivity, which is essential for providing full assistance for the literature process (Ellegaard & Wallin 2015). Although Bibliometrix will be covered in further length, it mainly works with, WoS (Web of Science), Scopus, PubMed, OpenAlex, Dimensions databases and other databases. An earlier study on palm leaf manuscripts, conservation, and preservation hasn't yet fully covered this topic under the Scopus database. The study expands to cover more sources of literature through the database. Thus, by offering potential direction for the scientific research output on palm leaf manuscripts, conservation, and preservation, this study is very important to fill the research gap in the field.

1.2 Objectives

The study objectives are as follows:

- To identify the format of palm leaf conservation and preservation research publications.
- To identify which journals are the most fruitful.
- To identify the most prolific authors and authorship patterns in studies on palm leaf conservation and preservation.
- To identify related scholars and affiliations.
- To determine which countries produce the most publications on palm leaf conservation and preservation.
- To identify the most popular keywords.

1.3 Limitations of the Study

This study is considered a bibliometric study on palm leaf conservation and preservation methods. This study considered only the palm leaf manuscript, Conservation of palm leaf manuscript and Preservation of Palm leaf manuscript keywords. The study did not consider the keyword "Ola leaf manuscripts". The study period was from 2002 to 2021. All sources were in English. The biblioshiny package was used for data analysis.

1 RESEARCH METHODOLOGY / MATERIALS AND METHODS

2.1 Bibliometric analysis

Bibliometric analysis is the application of statistical and mathematical tools to books and media communication (Andrés 2009). The statistical analysis of written publications, such as books, articles or other publications, is known as bibliometric (OECD 1997). In the discipline of library and information science as well as other fields, bibliometrics is frequently used to provide quantitative analysis of academia. According to the British Standard Institution, bibliometric is "the study of the usage of documents and patterns of publication in which mathematical and statistical tools are applied." Thus, the purpose of bibliometric analysis is to describe, contrast, and measure the significance of scientific work. Additionally, by locating the top journals for publication, identifying possible collaborators, locating potential study areas, and other information, bibliometric data will increase the visibility and impact of research (Sulistyo-Basuki 2002).

2.2 Data sources

The research articles were retrieved from the Scopus database (https://www.scopus.com). Scopus is truly the largest abstract and citation database in the world, with more than 81 million entries from more than 7000 publishers in 105 countries and 17 million author profiles (Elsevier 2023).

Table 1: The study keywords

No	Keywords
1	Palm leaf manuscripts
2	Palm leaf manuscripts conservation
3	Conservation and Preservation

Table 1 shows that the study keywords "palm leaf manuscripts, Palm leaf manuscripts conservation and conservation and preservation" were used to search publications in the SCOPUS database. A total of 101 documents were finally selected for the analysis. Each publication's entire records that were located during the search process were converted to a Scopus BibTex file and imported to Biblioshiny. In this study, the research status and trends in the field of palm leaf conservation and preservation are analyzed and shown using the biblioshiny package. The result was presented in tables, graphs, figures and maps.

2.3 Research software

This study used the 'biblioshiny', package and open-source Excel package for descriptive analysis of documents. The Biblioshiny is a tool included in the package that is made for non-coders and offers a variety of options separated into categories for sources, documents, authors, conceptual structure, social structure, and intellectual structure. The 'biblioshiny' interface for analysis is; Bradford's Law, global citation, h, g, and m-index. It offers means for comprehensive scientometric and bibliometric analysis. Multiple results can be obtained in the form of tables and graphs, which are uncommon in other software (Moral-Muñoz et al. 2020).

The following are the processes involved in installing and using biblioshiny:

1. Download the most recent versions of RStudio and the R language program.

URL: https://cran.r-project.org/ or URL: http://www.rstudio.com

2. Open RStudio and enter the following command in the control interface window to comprehensive the installation of the bibliometrix program:

install. packages ("bibliometrix")

3. Please select a CRAN mirror for use in this session. Example:- USA (MI) [https]

4. Enter the following command to invoke and open the bibliometrix and biblioshiny programme.

library(bibliometrix)

5. To start with the biblioshiny package, please enter the digit: biblioshiny ( )

6. Start bibliometric analysis through biblioshiny.

Figure 1 shows that steps to complete the process of bibliometric analysis of palm leaf conservation and preservation.

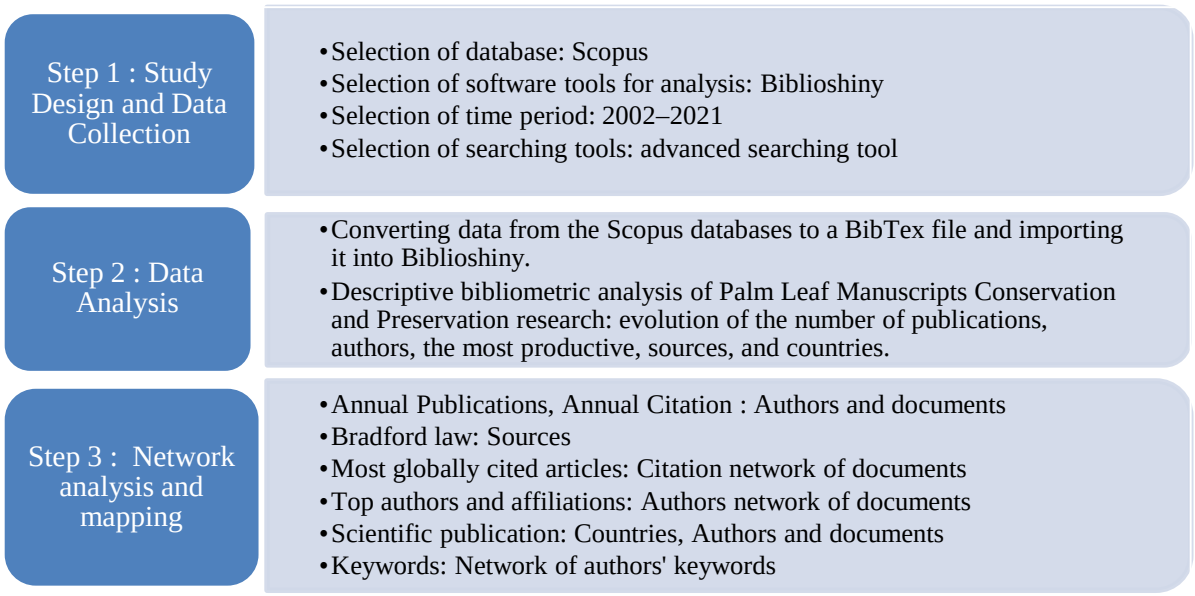

Figure 1. The procedure of Bibliometric Analysis**.**

3 RESULTS & DISCUSSION

In this section, results and discussions of findings are accessible to show: (i) To identify the format of palm leaf conservation and preservation research publications; (ii) To identify the most relevant sources and documents in the field of palm leaf conservation and preservation publications; (iii) To identify the most relevant prolific scholars and affiliations in the field of palm leaf conservation and preservation; (iv) To explore scientific publication production by counties; (v) To identify the global produce the most publications in the field of palm leaf conservation and preservation; (vi) To identify the most popular author's keywords in the field of palm leaf conservation and preservation.

3.1 Identify the format of palm leaf conservation and preservation research publications

The volume of articles published in science each year on the topic of palm leaf conservation and preservation is presented in this part.

Table 2. Primary information and summary of the dataset

Description	Results
Timespan	2002:2021
Sources (Journals, Books, etc)	68
Documents	101
Annual Growth Rate %	11.32
Document Average Age	6.03
Average citations per doc	3.812
References	5169
DOCUMENT TYPES	
Article	84
conference paper	2
Editorial	1
Review	14
DOCUMENT CONTENTS	
Keywords Plus (ID)	175
Author's Keywords (DE)	347
AUTHORS	
Authors	178
Authors of single-authored docs	62
AUTHORS COLLABORATION	
Single-authored docs	65
Co-Authors per Doc	1.87
International co-authorships %	6.931

As shown in Table 2. The literature on palm leaf preservation and conservation covers only the selected period. The 101 publications included 84 journal articles, 2 conference papers, 1 editorial, and 14 reviews. A total of 240 authors wrote these documents; among them, only 62 articles had a single author. All these publications used 175 keywords plus 347 author keywords. The low level of collaboration in the palm leaf conservation and preservation publication that was shown by the co-authors per document is 1.87. Most of the publications were written by one author.

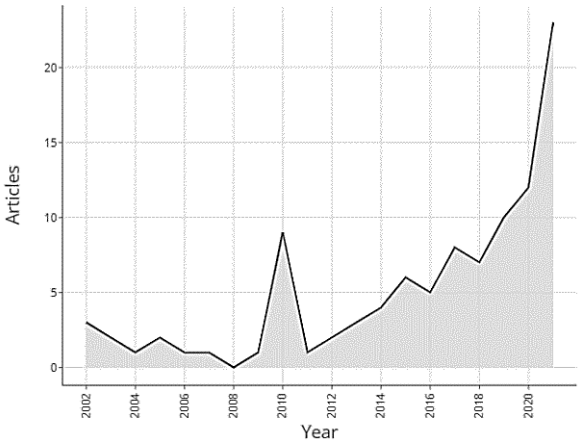

Figure 2. Publications for palm leaf conservation and preservation are produced annually.

The annual production of palm leaf conservation and preservation is depicted in Figure 2. Initially, there were few publications, but that gradually changed as time went on. There were 9 articles published in 2010, indicating the start of the field's significant increase in publication. When 10 papers were published in 2019, this growth abruptly picked up. The highest publishing per year thus far was in 2020, when 12 articles were published, and in 2021, when 23 articles were published. Because the field of palm leaf conservation and preservation is still in its early stages, the scientific contribution is expected to grow year after year, as revealed by the results of the analysis.

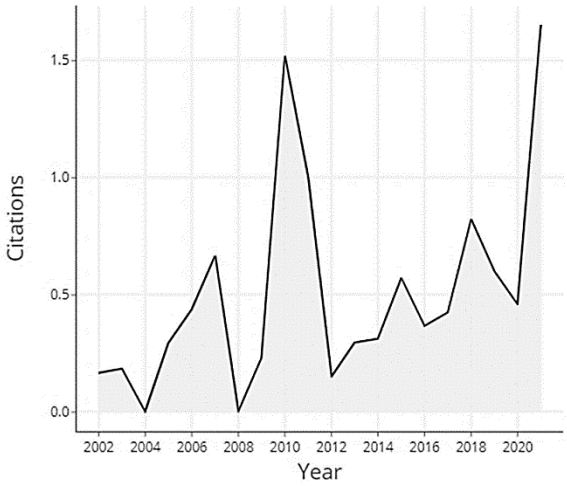

Figure 3. Average citation per year

Figure 3 presents the average number of citations per year for palm leaf conservation and preservation. This outcome demonstrates how much of an annual impact the publication has on the sector. The result indicates that the average number of citations per year grew from 1.52 in 2010 to 1.65 in 2021, which was the highest number of citations recorded so far. Authors published more publications in both years, which contributed to the increase in citations. This amount fell significantly from 0.17 in 2002 to 0.23 in 2009 and from 0.15 in 2012 to 0.46 in 2020.

3.2 Relevant sources and documents in the field of palm leaf conservation and preservation publications

Table 3. Publication rankings according to Bradford law

Sources	Rank	Freq	cumFreq	Zone
LIBRARY PHILOSOPHY AND PRACTICE	1	6	6	Zone 1
RESTAURATOR	2	6	12	Zone 1
JOURNAL OF INDIAN PHILOSOPHY	3	5	17	Zone 1
RELIGIONS	4	4	21	Zone 1
ACTA ASIATICA VARSOVIENSIA	5	2	23	Zone 1

ARTIBUS ASIAE	6	2	25	Zone 1
BIJDRAGEN TOT DE TAAL-, LAND- EN VOLKENK-UNDE	7	2	27	Zone 1
CONTEMPORARY BUDDHISM	8	2	29	Zone 1
INTERNATIONAL JOURNAL OF CONSERVATION SCIENCE	9	2	31	Zone 1
INTERNATIONAL JOURNAL OF SCIENTIFIC AND TECHNOLOGY RESEARCH	10	2	33	Zone 1
ITINERARIO	11	2	35	Zone 1
JOURNAL OF BURMA STUDIES	12	2	37	Zone 2
JOURNAL OF ETHNOBIOLOGY AND ETHNOMEDICINE	13	2	39	Zone 2
JOURNAL OF HINDU STUDIES	14	2	41	Zone 2
KERVAN	15	2	43	Zone 2
MANUSCRIPT STUDIES	16	2	45	Zone 2
NUMEN	17	2	47	Zone 2
RELIGIONS OF SOUTH ASIA	18	2	49	Zone 2
SOUTHEAST ASIAN STUDIES	19	2	51	Zone 2
WEBOLOGY	20	2	53	Zone 2

Further investigation in Table 3 reveals that the highest sources were library philosophy and practice with 06 documents and restaurateur with 06 documents. The Journal of Indian Philosophy, with five documents, and Religions, with four documents, were the next most relevant sources. Researchers and decision-makers should read these sources because they provide useful information for palm leaf conservation and preservation. Two documents were rests of other sources.

Table 4. Most globally cited articles

No	Document title	Authors & Year Published	Publication source	Global Total citation
1	Sciences and the global on methods, questions, and theory	Sivasund-aram, S, 2010	ISIS	113
2	Pigments — Mercury-based red (cinnabar-vermilion) and white (calomel) and their degradation products	GLIOZZO E, 2021	Archaeolo-gical and Anthropo-logical Sciences	27
3	Social relationships and shifting languages in Northern Thailand	HOWARD KM, 2010	Journal of Socioling-uistics	12
4	Land Donations and the Gift of Water. On Temple Landlordism and Irrigation Agriculture in Pre-Colonial Bali	Hauser-Schäublin B. 2011	Human Ecology	11
5	The convergence of information technology, data, and management in a library imaging program	France F.G., Emery D., Toth M.B. 2010	Library Quarterly	11
6	The effect of linalool vapour on silver-gelatine photographs and bookbinding leathers	Rakotonir-ainy M.S., Juchauld F., Gillet M., Othman-Choulak M., Lavedrine B. 2007	Restaurator	10
7	Plus ça change ... Recent developments in Old Javanese studies and their implications for the study of religion in contemporary Bali	Fox R. 2005	Bijdragen tot de Taal-, Land- en Volkenkunde	10
8	Culture and language promotion in Thailand: implications for the Thai Lao minority of introducing multilingual signage	Draper J., Nilaiyaka A. 2015	Asian Ethnicity	9
9	The Use of Traditional Conservation Methods in the Preservation of Ancient Manuscripts: A	Rachman Y.B. 2017	Preservation, Digital Technology and Culture	8

	Case Study from Indonesia			
10	A selective review of scholarly communications on palm leaf manuscripts	SAHOO J, 2016	Library Philosophy and practice	8

The top ten globally cited documents in the field of palm leaf conservation and preservation have been identified in Table 4. On top of the list, Sivasundaram S. conducted a study in 2010 on the Sciences and the global methods, questions, and theory. The study from GLIOZZO E was second on the list of the most globally cited articles. In 2021, the study looked into mercury-based red (cinnabar-vermilion) and white (calomel) pigments and their degradation products. Third on the list, HOWARD KM discussed social relationships and shifting languages in Northern Thailand in 2010.

3.3 Prolific Scholars and Affiliations

Table 5. Top twenty most relevant authors in the field of palm leaf conservation and preservation.

Authors	Articles	Articles Fractionalized
DRAPER J	3	1.67
SHARMA D	3	1.08
JARUSAWAT P	2	1.33
KIM J	2	2.00
NAIR BJB	2	0.53
RACHMAN YB	2	2.00
SAHOO J	2	1.25
SINGH MR	2	0.83
SIVASUNDARAM S	2	2.00
ACHARYA D	1	1.00
AHUJA NJ	1	0.50
AKARSH AM	1	0.20
ALLINGER E	1	0.50
ALRASHEED N	1	0.33
ANAND T NS	1	0.20
ANSHORI S	1	0.20
ASHOK G	1	0.33
BAIRD IG	1	1.00
BAQUEE A	1	0.50
BARAZER-BILLORET M-L	1	1.00

Based on the dataset, Table 5 highlights the most relevant scholars in the field of palm leaf conservation and preservation from 2002 to 2021. These researchers have consistently added to the body of research in this area. The author Draper J. from Thailand, who created a total of 3 publications, received the highest number of citations (1.67), according to the findings. He published three articles in the area. The first paper by Draper J, which had a total of 3 citations, appeared in 2013. His second article was published in 2015 and received 9 total citations, while his most recent publication was in 2019 and received 3 total citations. Draper J hasn't written anything as of 2021, although from 2013 to 2021, he routinely published in this field. India's Sharma D. is the second-most important author in this discipline. The three publications published in the field first and second publications were published in 2018, and the final publication was published in 2020.

He received 12 citations in total. Similarly, the result shows that 7 authors published 2 publications, and the rest of the authors also published 1 publication.

3.3.1 Affiliations

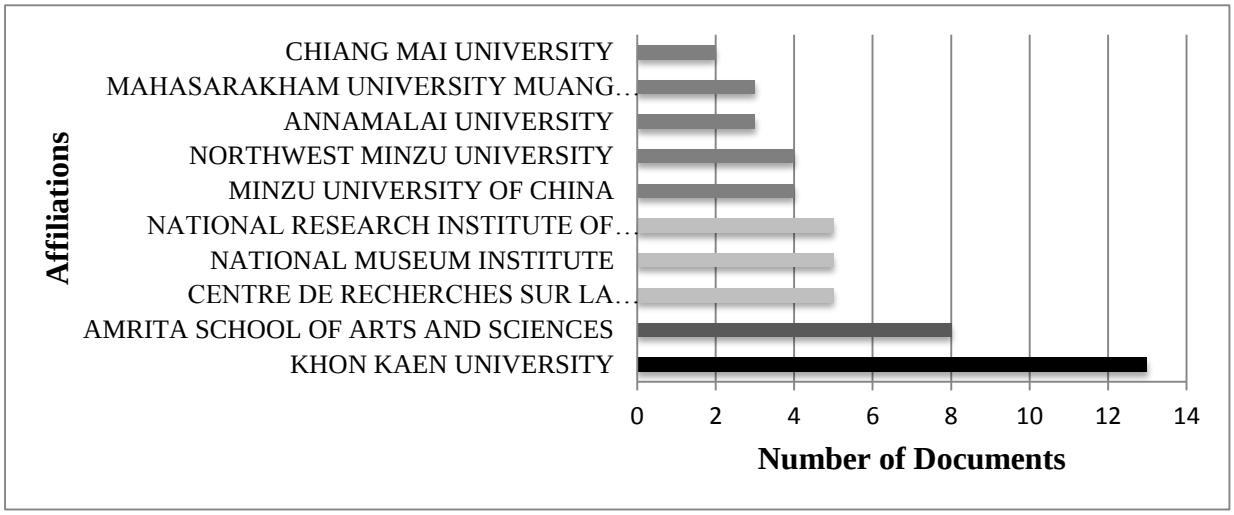

Figure 4. Most Relevant Affiliations.

The most relevant affiliations were reported in Figure 4. The University of Khon Kaen in Thailand was in first place. The Amrita School of Art and Sciences in India was second on the list of most relevant affiliations. Third on the affiliate list was France's Center de Recherches sur la Conservation des Collections (CRCC), followed by India's National Institute of Museums and South Korea's National Research Institute of Cultural Heritage in fourth.

3.4 Scientific publication production by counties

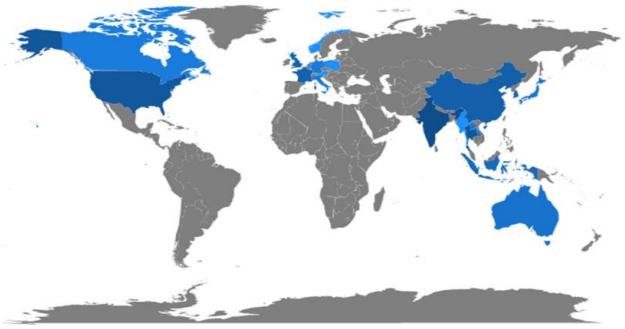

Figure 5. Country Scientific Production of palm leaf conservation and preservation.

Figure 5 shows that India had the most publications in the field in Asia, with 45. Thailand and the United States came in second with 24 publications each, while China came in third with 15 publications. Indonesia, Japan, Myanmar, Singapore and South Korea normally contributed to the field. Most publications in the field were published in Asian countries. There was a lack of dataset-related publications in Sri Lanka. Australia actively contributed to the field. France, Germany, Italy, Laos, Netherlands and UK actively contributed to the field. The continents of Africa and South America did not contribute to the field.

Table 6. Most cited countries in the field of palm leaf conservation and preservation

No	Country	Total Citations (CT)	Average Article Citations
1	UNITED KINGDOM	131	21.83
2	USA	54	4.15
3	INDIA	28	1.65
4	ITALY	27	27.00
5	THAILAND	16	2.29
6	INDONESIA	15	5.00
7	GERMANY	12	4.00
8	CHINA	11	2.75
9	FRANCE	10	5.00
10	LAOS	7	7.00
11	JAPAN	4	1.33
12	NETHERLANDS	4	4.00
13	SINGAPORE	4	4.00
14	AUSTRALIA	3	3.00
15	KOREA	1	0.50
16	MYANMAR	1	1.00

According to Table 6, the United Kingdom has 131 citations, with the top citation having 21.83 citations per average article. The United States came in second, with 54 citations and an average of 4.15 per average article citation. India is ranked third, but they only have 28 citations, with an average of 1.65 per average article citation. Italy, Indonesia, and Germany were the only countries that published a few publications, but their citation impacts were enormous. China, France and Laos have significant citations in the field.

3.5 Keywords analysis

Figure 6. Word Cloud.

Figure 6 shows the word cloud made from the author's keywords. Manuscript, Digitization, Buddhism and Conservation were the highest frequency in the literature on palm leaf conservation and preservation. The manuscript was the most frequently used word in the references and abstract. Digitization was the most commonly used word in the abstract. In the references, the word "conservation" was used. India and Nepal were the country names that were second in frequency in the field. Some studies link the manuscript with Buddhism. Conservation and preservation were used as keywords in the literature.

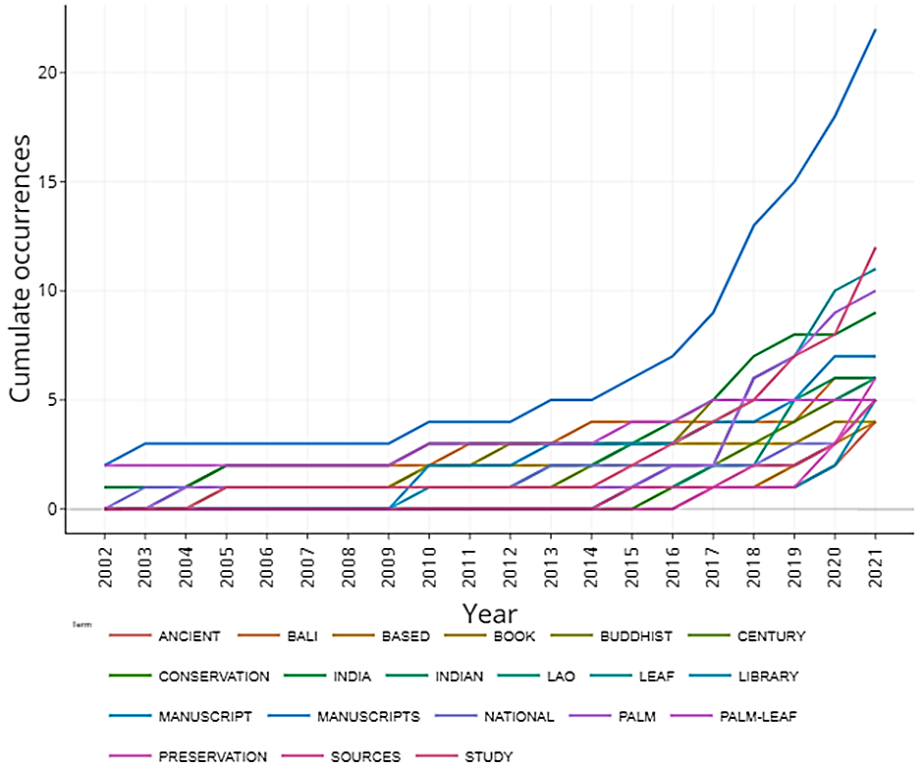

Figure 7. Title growth over time

In addition to the word cloud, figure 7 shows title growth in literature over time. From 2002 to 2014, the manuscript title grew slowly, but it increased after 2015. Conservation began in 2015 and increased dramatically by 2021. Preservation began in 2018 and continues until 2021.

4 CONCLUSION & RECOMMENDATIONS

The bibliometric analysis of the preservation and conservation of palm leaf manuscripts has not been done based on the Scopus database. The highest publication year was 2021 when 23 articles were published. The top three journals in terms of the number of highly cited articles were Philosophy and Practice, Restaurant, and Journal of Indian Philosophy. The article "Sciences and the global on methods, questions and theory" by Sivasundaram S has the most citations (113). The article "Pigments-Mercury-based red (cinnabar-vermillion) and white (calomel) and their degradation products" by GLIOZZO E has the second most citations (27). The top author in the field of palm leaf preservation and conservation is Draper J. from Thailand, who presented 3 papers and received the highest citation count of 1.67. India, Thailand, the United States, and China were identified as the top four scientific publishing countries. As the most productive institution in Thailand, the University of Khon Kaen had the strongest relevant affiliations for palm leaf manuscript conservation and preservation. The second most productive institution in India was the Amrita School of Art and Sciences. The Most cited country was the United Kingdom. The top four author keywords were "manuscript," "digitization," "buddhism," and "conservation". The study recommends that this study cover only the literature available in the Scopus database. It is suggested that future studies be conducted from a broader perspective by covering other relevant databases and using bibliometric software and packages. Further, this study recommends conducting bibliometric analysis continually to elaborate on the findings of palm leaf manuscript preservation and conservation.

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