

# Managing the World's Largest Religious Gathering: A Scopus-Based Bibliometric Analysis of Hajj and Muslim Pilgrimage Management Research

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## ABSTRACT

This bibliometric study systematically maps the scholarly landscape of Hajj and Muslim pilgrimage management from 2011 to 2025. While the Hajj represents a profound religious obligation for millions of Muslims, its scale presents complex challenges in crowd control, public health, logistics, and governance, yet a comprehensive overview of the academic discourse remains limited. Addressing this gap, we employed a rigorous bibliometric methodology using Scopus as the data source, applying the Boolean query TITLE((managem\*) AND (haj\* OR pilgrim\* OR "mass gathering")) to identify relevant literature. After screening 147 initial records against inclusion criteria: peer-reviewed, English-language journal articles published between 2011 and 2025, we retained a final dataset of 65 articles. Data were cleaned and standardized using OpenRefine, while bibliometric indicators (publication trends, subject areas, country contributions, and citation impact) were extracted using Scopus Analyzer. Thematic and network analyses including co-authorship and keyword co-occurrence were conducted via VOSviewer. Findings reveal a steady increase in research output, peaking in 2022 and 2025 (9 articles each), and highlight strong interdisciplinary engagement across Social Sciences (18 articles), Computer Science (17), Engineering (14), and Medicine (14). Saudi Arabia leads in publication output (21 articles), followed by Indonesia (12) and Malaysia (8). Key thematic clusters include crowd management, digital technologies (e.g., AI, UAVs), public health, sustainability, and religious tourism governance. Highly cited works emphasize emergency response systems and smart solutions for mass gatherings. This study not only charts the intellectual evolution of the field but also identifies emerging trends and research gaps, offering valuable insights for scholars and policymakers committed to enhancing the safety, efficiency, and spiritual integrity of Hajj management in alignment with global standards and Saudi Vision 2030.

## INTRODUCTION

The Hajj pilgrimage, one of the five pillars of Islam, is a significant religious event that attracts millions of Muslims to Mecca, Saudi Arabia, annually. This mass gathering poses numerous challenges in terms of crowd management, logistics, and safety. Effective management strategies are crucial to ensure the safety and well-being of pilgrims, as well as to enhance their overall experience. This introduction and literature review will explore the various aspects of Hajj management, including crowd control, financial management, technological advancements, and the socio-economic impacts of the pilgrimage.

This study aims to systematically examine the scholarly landscape of research on Hajj and Muslim pilgrimage management through a bibliometric approach. Using publications indexed in Scopus, the paper analyzes the temporal growth of literature, citation structures, influential authors and institutions, core journals, and thematic concentrations related to pilgrimage management, including crowd control, logistics, safety, financial

governance, technological applications, and socio-economic impacts. By mapping intellectual trends and research networks through performance indicators and science-mapping techniques, this study seeks to identify dominant research themes, emerging topics, and underexplored areas within the field. The findings are intended to contribute to a clearer understanding of the evolution and structure of Hajj management research and to inform future academic inquiry and policy-oriented decision-making.

## LITERATURE REVIEW

### Crowd Management

Managing the massive influx of pilgrims during Hajj is a complex task that involves ensuring safety and preventing overcrowding. Studies have highlighted the importance of advanced simulation tools and urban design to optimize pedestrian pathways and prevent bottlenecks, especially during high-density periods like Nahr day (Kadi et al., 2024). Despite the use of state-of-the-art infrastructure and communication technologies, challenges such as stampedes and congestion persist, necessitating continuous improvement in crowd management strategies (Alabdulkarim et al., 2016; Owaidah et al., 2019). The integration of technologies like Unmanned Aerial Vehicles (UAVs) and Mobile Crowd Sensing and Computing (MCSC) has been proposed to enhance crowd analytics and monitoring (Owaidah et al., 2019).

### Financial Management

The management of Hajj funds is another critical aspect, particularly in countries like Indonesia, where the Hajj Financial Management Agency (BPKH) faces challenges in governance and institutional coordination. Strategies such as investment policy development, internal control enhancement, and technology adoption are recommended to improve fund management and ensure public accountability (Zulkarnain et al., 2025). Aligning investments with Islamic principles and strengthening controls against fund misuse are essential for optimizing Hajj fund management (Zulkarnain et al., 2025).

### Technological Advancements

Technological innovations play a significant role in improving the management of Hajj. The use of digital technologies, including wireless communication, computer vision, spatial computing, and data analytics, has been explored to enhance crowd management and service provision (Felemban et al., 2020). Augmented Reality (AR) applications have been developed to assist pilgrims in recognizing important sites and rituals, optimizing routes, and improving overall pilgrimage planning (Alsulami et al., 2025). These advancements contribute to a more efficient and safer Hajj experience.

### Socio-Economic Impacts

The Hajj pilgrimage has profound socio-economic impacts on local communities and the broader economy. The influx of pilgrims stimulates the tourism sector, creating economic opportunities and boosting local economies (Lo Giacco, 2020; Parga-Dans, 2015). However, the commodification of Hajj, driven by the desire to maximize economic benefits, raises concerns about the authenticity of the pilgrimage experience and its alignment with Islamic values (Qurashi, 2017). The balance between economic development and maintaining the spiritual essence of Hajj is a critical consideration for policymakers.

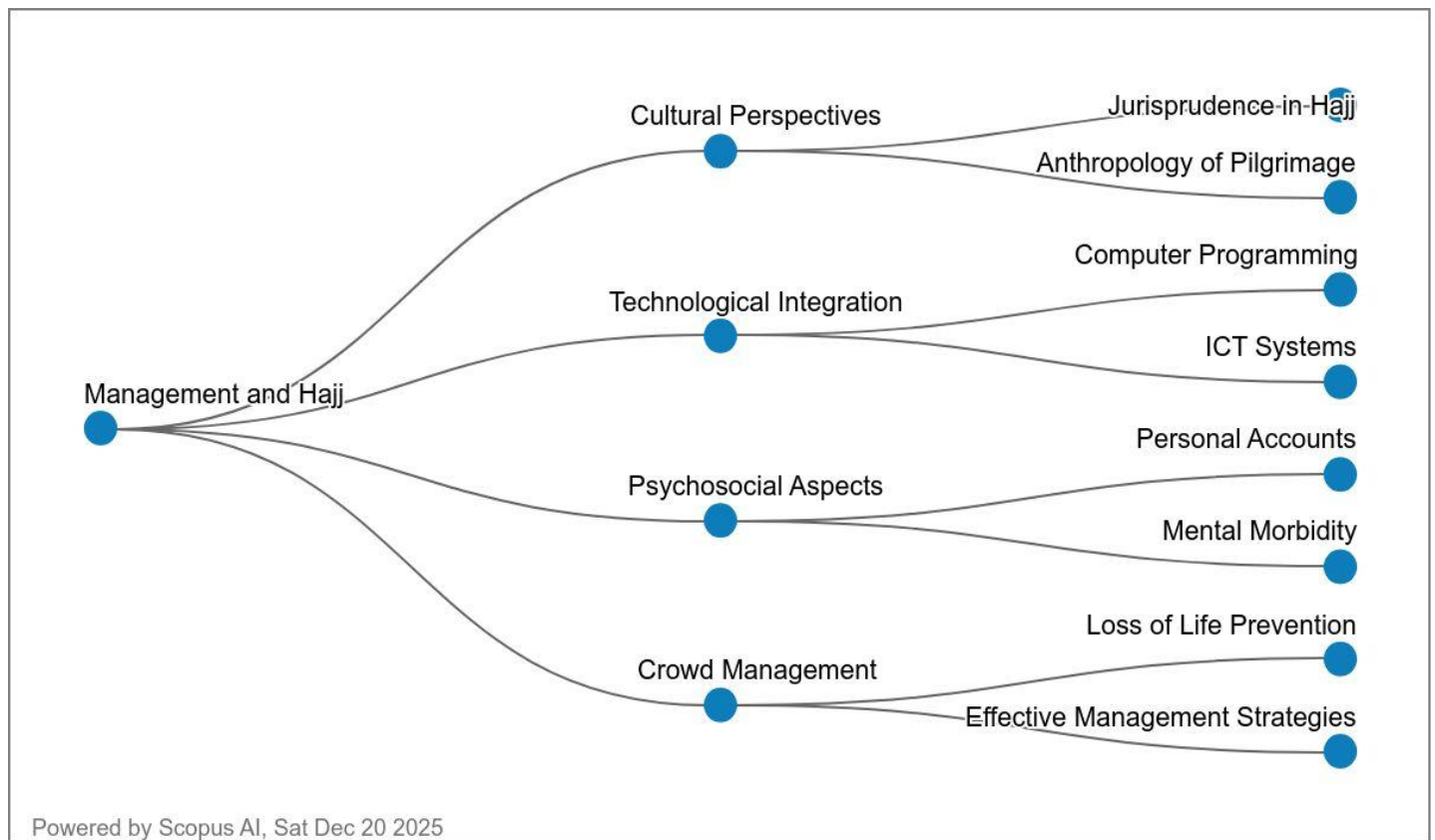
### Environmental And Health Considerations

Environmental management is an emerging focus in Hajj management, with efforts to implement eco-friendly practices such as recycling, waste management, and energy efficiency (Elgammal & Alhothali, 2021; Khan et al., 2025). The COVID-19 pandemic has further highlighted the need for robust health administration and safety measures to prevent the spread of infections during mass gatherings (Karia & Mahmoud Saleh, 2023; Supriadi et al., 2022). Ensuring the health and safety of pilgrims through effective health administration and environmental management is essential for the sustainability of the Hajj pilgrimage.

In conclusion, the management of the Hajj pilgrimage encompasses a wide range of challenges and considerations, from crowd control and financial management to technological advancements and socio-

economic impacts. Continuous improvement and innovation in these areas are crucial to ensure the safety, efficiency, and spiritual fulfillment of the millions of Muslims who undertake this sacred journey each year. The integration of advanced technologies, effective governance, and sustainable practices will play a pivotal role in enhancing the overall Hajj experience and achieving the goals of Saudi Vision 2030.

Figure 1. Overview of Literature



## RESEARCH QUESTIONS

1. What are the annual publication trends in research on Hajj and Muslim pilgrimage management from 2011 to 2025?
2. Which subject areas and disciplinary domains have contributed most significantly to the scholarly literature on Hajj and Muslim pilgrimage management?
3. Which journal articles are the most influential in the field of Hajj and Muslim pilgrimage management research, as measured by citation impact?
4. Which countries and institutions have emerged as leading contributors to research on Hajj and Muslim pilgrimage management?
5. What are the most frequently occurring keywords and thematic clusters in the literature on Hajj and Muslim pilgrimage management?

## METHODOLOGY

The bibliometric analysis covers publications published between 2011 and 2025, fully aligning with the applied search string and inclusion criteria. Bibliometrics refers to the systematic collection, organisation, and quantitative analysis of bibliographic data derived from scientific publications (Alves et al., 2021; Assyakur & Rosa, 2022; Verbeek et al., 2002). In addition to conventional descriptive analyses, such as identifying influential journals, publication trends over time, and highly productive authors (Wu et al., 2017), bibliometric studies employ advanced analytical techniques, including document co-citation analysis, to uncover intellectual structures within a research field. Conducting a comprehensive literature review requires a rigorous and iterative

process involving careful keyword selection, extensive database searches, and systematic data analysis. This methodological rigor facilitates the development of a comprehensive and reliable bibliographic dataset (Fahimnia et al., 2015). In line with this approach, the present study concentrates on high-impact scholarly publications to generate meaningful insights into the theoretical foundations of the field. To ensure data reliability and accuracy, the SCOPUS database was used as the primary data source (Al-Khoury, 2022; di Stefano et al., 2010; Khiste et al., 2017). This study adopts a Scopus-based bibliometric approach, focusing exclusively on peer-reviewed journal articles indexed in Scopus. While conference proceedings and book chapters were reviewed for contextual understanding and conceptual framing, they were not included in the bibliometric dataset or quantitative analyses. The analysis was restricted to peer-reviewed journal articles, while books and lecture notes were intentionally excluded (Gu et al., 2019). Bibliographic records spanning the period from 2011 to 2025 were retrieved from Elsevier's SCOPUS database, which is widely recognised for its extensive multidisciplinary coverage.

## Data Search Strategy

A systematic and replicable search strategy was employed to ensure the accuracy and robustness of data collection. The literature search was conducted exclusively in the Scopus database, with a Boolean search string applied only to the article title field, in order to capture publications with a direct and explicit focus on the research topic. The search string used is presented in Table 1:

Search string:

TITLE ( ( managem\* ) AND ( haj\* OR pilgrim\* OR "mass gathering" ) ) AND PUBYEAR > 2009 AND PUBYEAR < 2026 AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( PUBSTAGE , "final" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )

The initial search yielded 147 records. A multi-stage screening process was subsequently undertaken to refine the dataset based on predefined inclusion and exclusion criteria (Table 2).

The inclusion criteria comprised peer-reviewed journal articles written in English, indexed in Scopus, published at the Final publication stage, and falling within the time span of 2011–2025. The exclusion criteria encompassed books, book chapters, conference proceedings, review articles, lecture notes, articles in press, and other non-academic publications.

Following the application of these criteria, a final dataset of 65 articles was retained for bibliometric analysis.

All bibliographic records were exported in CSV format and subjected to data cleaning and standardisation using OpenRefine. Bibliometric mapping and network visualisation covering co-authorship networks, keyword co-occurrence, and citation relationships were conducted using VOSviewer. Descriptive bibliometric indicators, including annual publication trends, prolific authors, core journals, country contributions, and frequently used keywords, were generated using the Scopus Analyzer tool.

**Table 1. Search String Used in the Study**

Database	Search Field	Search String
Scopus	Title only	TITLE ( ( managem* ) AND ( haj* OR pilgrim* OR "mass gathering" ) ) AND PUBYEAR > 2009 AND PUBYEAR < 2026 AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( PUBSTAGE , "final" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) )

**Table 2. Inclusion and Exclusion Criteria**

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2011–2025	Before 2011
Document Type	Journal Articles	Conferences, Books, Reviews
Publication Stage	Final	Articles in Press

## Data Analysis

The bibliometric analysis in this study was conducted using VOSviewer, a widely recognised bibliometric mapping and visualisation software developed by Nees Jan van Eck and Ludo Waltman of Leiden University, the Netherlands (van Eck & Waltman, 2010, 2017). VOSviewer is particularly effective for constructing and visualising large-scale bibliometric networks, including co-authorship, co-citation, keyword co-occurrence, and citation networks, making it well suited for identifying structural patterns and research trends within a specific scholarly domain. In the present study, the software was employed to examine the intellectual structure and thematic development of research on Hajj and Muslim pilgrimage management.

Unlike traditional Multidimensional Scaling (MDS) techniques, VOSviewer utilises a proprietary layout algorithm that positions items in a low-dimensional space based on similarity measures, resulting in clearer and more interpretable visual representations of bibliometric relationships (Appio et al., 2014; van Eck & Waltman, 2010). A central feature of this approach is the association strength ( $AS_{ij}$ ) normalization method, which determines the strength of the relationship between two items in a network (van Eck & Waltman, 2007). The association strength is calculated as:

$$AS_{ij} = \frac{C_{ij}}{w_i w_j}$$

where  $C_{ij}$  denotes the number of co-occurrences between items  $i$  and  $j$ , and  $w_i$  and  $w_j$  represent the total occurrences of items  $i$  and  $j$ , respectively. This measure evaluates the extent to which two items co-occur relative to their overall frequencies, enabling a more meaningful interpretation of conceptual, collaborative, and citation-based relationships.

Bibliometric data were retrieved from the Scopus database, covering publications from 2011 to 2025. The dataset included essential bibliographic metadata such as article titles, author names, source journals, publication years, author affiliations, keywords, and citation counts. Consistent with the study's selection criteria, only peer-reviewed journal articles written in English, indexed in Scopus and published at the Final publication stage, were included. Books, book chapters, conference proceedings, lecture notes, articles in press, and non-academic publications were excluded.

All records were exported in CSV format and subsequently cleaned and standardised using OpenRefine to address issues such as author name variations and keyword inconsistencies. The refined dataset was then analysed using VOSviewer (version 1.6.19) to generate bibliometric networks across the following analytical dimensions:

- Keyword co-occurrence analysis, to identify dominant themes and emerging research topics in Hajj and Muslim pilgrimage management;



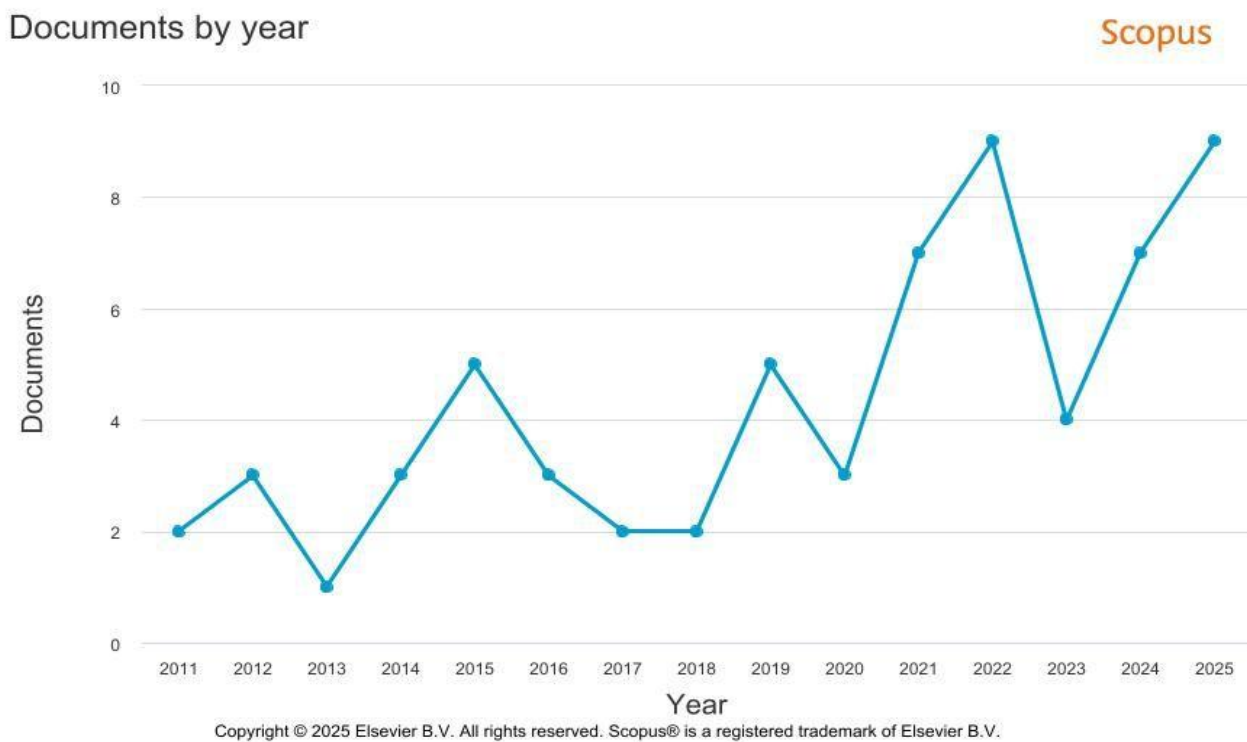
- Co-authorship analysis, to examine collaboration patterns among authors, institutions, and countries;
- Citation analysis, to identify influential publications and assess their impact within the field.

The resulting visual maps incorporate clustering techniques, colour-coded thematic groups, and density visualisations, offering comprehensive insights into the intellectual structure, thematic evolution, and collaborative dynamics of Hajj and Muslim pilgrimage management research over the past two decades.

## FINDINGS

1. What are the annual publication trends in research on Hajj and Muslim pilgrimage management from 2011 to 2025?

Figure 2. Annual publication trends in Hajj and Muslim pilgrimage management research (2011–2025)



Source: Adapted from Scopus Database, accessed on 20 December 2025 (<https://www.scopus.com>)

Table 3. Yearly Distribution of Publications on Hajj and Muslim Pilgrimage Management (2011–2025)

Year	No. of Publication	Percentage	Year	No. of Publication	Percentage
2025	9	13.6	2017	2	3.0
2024	7	10.6	2016	3	4.5
2023	4	6.1	2015	5	7.6
2022	9	13.6	2014	3	4.5
2021	7	10.6	2013	1	1.5
2020	3	4.5	2012	3	4.5
2019	5	7.6	2011	2	3.0
2018	2	3.0			

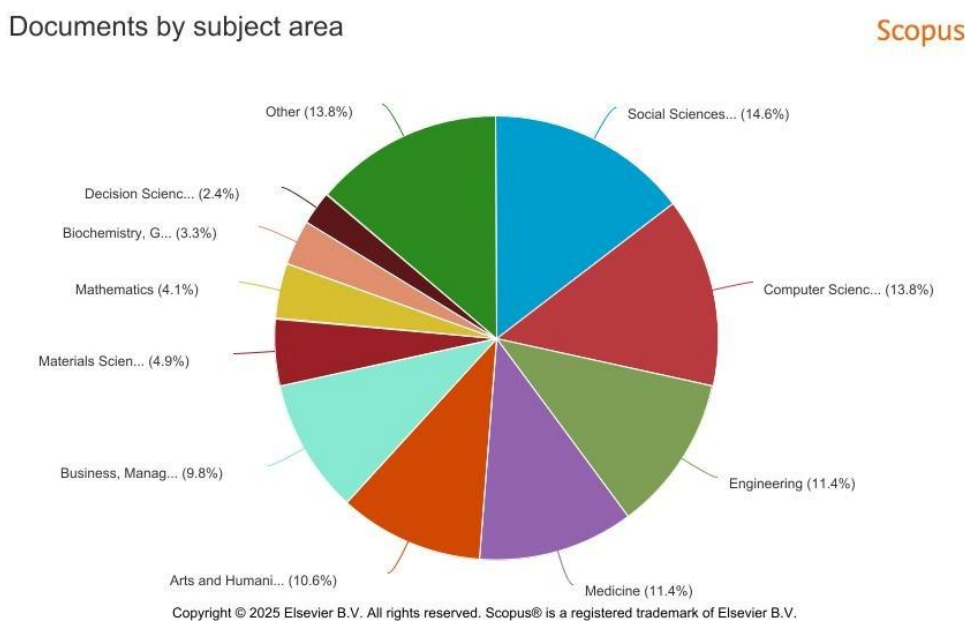
Source: Data retrieved from Scopus Database (<https://www.scopus.com>), accessed on 20 December 2025

Based on Table 3, the annual publication trends reveal a gradual but uneven growth in scholarly research on Hajj and Muslim pilgrimage management between 2011 and 2025, reflecting the evolving academic attention to managing the world's largest religious gathering. Early-stage research output between 2011 and 2015 remained relatively modest, with annual publications rarely exceeding five articles and contributing less than 8% each year. This limited output suggests that, during this period, Hajj management was largely approached as a peripheral topic, often embedded within broader discussions on public health, crowd control, or religious studies rather than being examined as a distinct management domain. The consistently low publication counts prior to 2015 indicate that systematic, management-oriented investigations into Hajj and Muslim pilgrimage were still in their formative stages.

A noticeable increase in publication activity emerges after 2018, with more pronounced peaks observed in 2022 and 2025, each accounting for 13.8% of the total publications. This upward trend corresponds with heightened global concern over mass gathering management, particularly in relation to crowd safety, logistics, risk mitigation, and post-pandemic governance of large-scale religious events. The surge in recent years reflects growing recognition of the Hajj as a complex, multidimensional management phenomenon requiring interdisciplinary approaches, including operations management, public policy, health management, and smart technology applications. Despite year-to-year fluctuations, the overall trend indicates a strengthening and maturation of the research field, suggesting that Hajj and Muslim pilgrimage management has increasingly been acknowledged as a critical area of scholarly inquiry aligned with contemporary challenges in managing large-scale religious gatherings.

2. Which subject areas and disciplinary domains have contributed most significantly to the scholarly literature on Hajj and Muslim pilgrimage management?

Figure 3. Subject Area Distribution of Publications on Hajj and Muslim Pilgrimage Management



Source: Adapted from Scopus Database, accessed on 20 December 2025 (<https://www.scopus.com>)

Table 4. Subject Area Distribution of Research on Hajj and Muslim Pilgrimage Management

Subject Area	No of Articles	Percentage
Social Sciences	18	14.6
Computer Science	17	13.8
Engineering	14	11.4
Medicine	14	11.4

<b>Arts and Humanities</b>	13	10.6
<b>Business, Management and Accounting</b>	12	9.8
<b>Materials Science</b>	6	4.9
<b>Mathematics</b>	5	4.1
<b>Biochemistry, Genetics and Molecular Biology</b>	4	3.3
<b>Decision Sciences</b>	3	2.4
<b>Environmental Science</b>	3	2.4
<b>Psychology</b>	3	2.4
<b>Energy</b>	2	1.6
<b>Multidisciplinary</b>	2	1.6
<b>Pharmacology, Toxicology and Pharmaceutics</b>	2	1.6
<b>Dentistry</b>	1	0.8
<b>Economics, Econometrics and Finance</b>	1	0.8
<b>Health Professions</b>	1	0.8
<b>Neuroscience</b>	1	0.8
<b>Physics and Astronomy</b>	1	0.8

Source: Data retrieved from Scopus Database (<https://www.scopus.com>), accessed on 20 December 2025

The subject area distribution presented in Table 4 demonstrates that research on Hajj and Muslim pilgrimage management is inherently interdisciplinary, reflecting the complexity of managing the world’s largest religious gathering. The most substantial contributions originate from the Social Sciences (14.6%), highlighting the strong emphasis on governance, policy formulation, organisational management, and social dynamics in pilgrimage contexts. Closely following are Computer Science (13.8%) and Engineering (11.4%), which underscore the growing reliance on technological and infrastructural solutions—such as crowd simulation, intelligent transportation systems, and data-driven decision-making—to address challenges related to crowd control, logistics, and safety during the Hajj. The significant representation of Medicine (11.4%) further reflects sustained scholarly attention to public health, disease prevention, and emergency response in large-scale mass gatherings, reinforcing the multidimensional nature of pilgrimage management.

In addition, notable contributions from the Arts and Humanities (10.6%) and Business, Management and Accounting (9.8%) indicate that Hajj management research extends beyond technical and operational concerns to encompass religious, cultural, ethical, and organisational perspectives. This disciplinary diversity highlights the need to balance spiritual objectives with efficient management practices in pilgrimage settings. Meanwhile, the presence of specialised fields such as Decision Sciences, Environmental Science, Psychology, and Materials Science, albeit with smaller proportions, points to emerging and complementary research angles, including behavioural studies, environmental sustainability, and infrastructure resilience. The relatively lower representation of economics- and finance-related disciplines suggests potential gaps in evaluating the economic governance and financial sustainability of pilgrimage management. Overall, the distribution affirms that scholarly inquiry into Hajj and Muslim pilgrimage management is evolving into a broad, interdisciplinary field, aligning with the complex managerial demands inherent in organising and sustaining the world’s largest annual religious gathering.

3. Which journal articles are the most influential in the field of Hajj and Muslim pilgrimage management research, as measured by citation impact?



Table 5. Top 10 Most Influential Journal Articles In Hajj and Muslim Pilgrimage Management Research Based on Citation Counts

Authors	Title	Year	Source title	Cited by
(Delir Haghighi et al., 2013)	Development and evaluation of ontology for intelligent decision support in medical emergency management for mass gatherings	2013	Decision Support Systems	165
(Henderson, 2011)	Religious tourism and its management: The hajj in Saudi Arabia	2011	International Journal of Tourism Research	122
(Danne et al., 2014)	The PILGRIM study: In silico modeling of a predictive low glucose management system and feasibility in youth with type 1 diabetes during exercise	2014	Diabetes Technology and Therapeutics	87
(Cardone et al., 2014)	Crowdsensing in Urban areas for city-scale mass gathering management: Geofencing and activity recognition	2014	IEEE Sensors Journal	82
(Felemban et al., 2020)	Digital Revolution for Hajj Crowd Management: A Technology Survey	2020	IEEE Access	62
(Shinde, 2012)	Policy, planning, and management for religious tourism in Indian pilgrimage sites	2012	Journal of Policy Research in Tourism, Leisure and Events	47
(Jimura, 2016)	World heritage site management: a case study of sacred sites and pilgrimage routes in the Kii mountain range, Japan	2016	Journal of Heritage Tourism	44
(Basahel et al., 2021)	Hajj and Umrah management during COVID-19	2021	International Journal of Information Technology (Singapore)	37
(Abalkhail & Al Amri, 2022)	Saudi Arabia's Management of the Hajj Season through Artificial Intelligence and Sustainability	2022	Sustainability (Switzerland)	31
(Albattah et al., 2020)	Hajj crowd management using CNN-based approach	2020	Computers, Materials and Continua	24

Source: Data retrieved from Scopus Database (<https://www.scopus.com>), accessed on 20 December 2025

The citation analysis presented in Table 5 identifies the most influential journal articles shaping scholarly discourse on Hajj and Muslim pilgrimage management, as measured by citation impact. The highly cited work by Delir Haghighi et al. (2013), which focuses on intelligent decision-support systems for medical emergency management during mass gatherings, leads the list with 165 citations, highlighting the centrality of health and emergency management in pilgrimage-related research. Similarly, Henderson's (2011) seminal study on religious tourism and Hajj management, with 122 citations, underscores the foundational role of tourism and management perspectives in conceptualising the Hajj as both a religious obligation and a large-scale organisational phenomenon. These early and widely cited contributions suggest that the field's intellectual foundations were initially shaped by broader mass gathering management and religious tourism frameworks before evolving into more specialised Hajj-focused studies.

More recent influential publications reflect a shift towards technology-driven and context-specific management solutions. Articles addressing crowd sensing, digital transformation, and artificial intelligence—such as those by

Cardone et al. (2014), Felemban et al. (2020), and Abalkhail and Al Amri (2022)—demonstrate the growing reliance on smart technologies to enhance crowd safety, operational efficiency, and sustainability during the Hajj. The inclusion of COVID-19–related research (Basahel et al., 2021) further illustrates how external crises have shaped contemporary research agendas. Notably, the diversity of source journals, spanning decision sciences, tourism studies, medical technology, engineering, and sustainability, reinforces the interdisciplinary nature of Hajj and Muslim pilgrimage management research. Overall, the citation patterns indicate a progression from conceptual and policy-oriented studies to technologically sophisticated and resilience-focused approaches, aligning with the increasing complexity of managing the world’s largest religious gathering.

4. Which countries and institutions have emerged as leading contributors to research on Hajj and Muslim pilgrimage management?

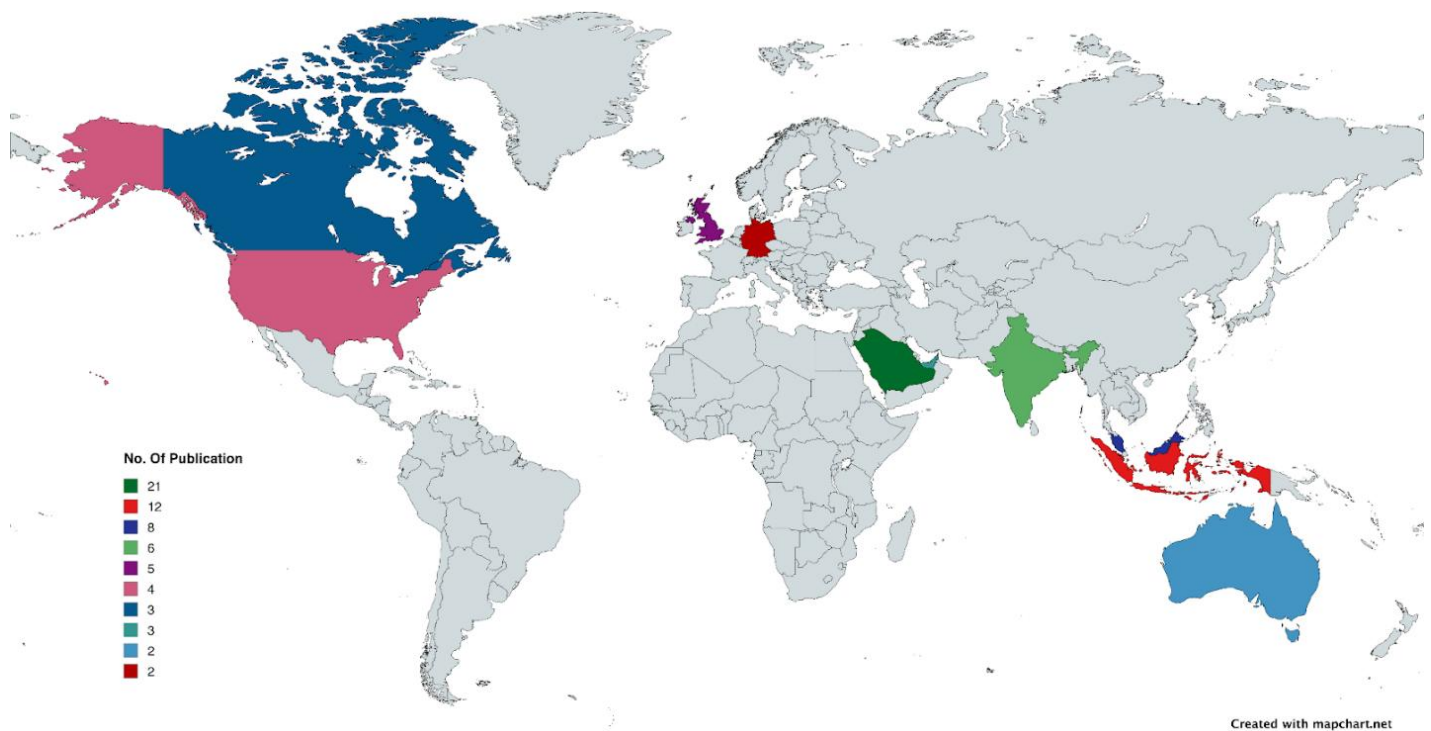


Figure 4. Geographic distribution of the top 10 contributing countries in Hajj and Muslim pilgrimage management research

Source: Visualisation generated using MapChart.net based on data retrieved from the Scopus database (accessed 20 December 2025).

Table 6. Top 10 countries by publication output in Hajj and Muslim pilgrimage management research

COUNTRY/TERRITORY	No. Of Publication	Percentage
<b>Saudi Arabia</b>	21	25.6
<b>Indonesia</b>	12	14.6
<b>Malaysia</b>	8	9.8
<b>India</b>	6	7.3
<b>United Kingdom</b>	5	6.1
<b>United States</b>	4	4.9
<b>Canada</b>	3	3.7
<b>United Arab Emirates</b>	3	3.7
<b>Australia</b>	2	2.4
<b>Germany</b>	2	2.4

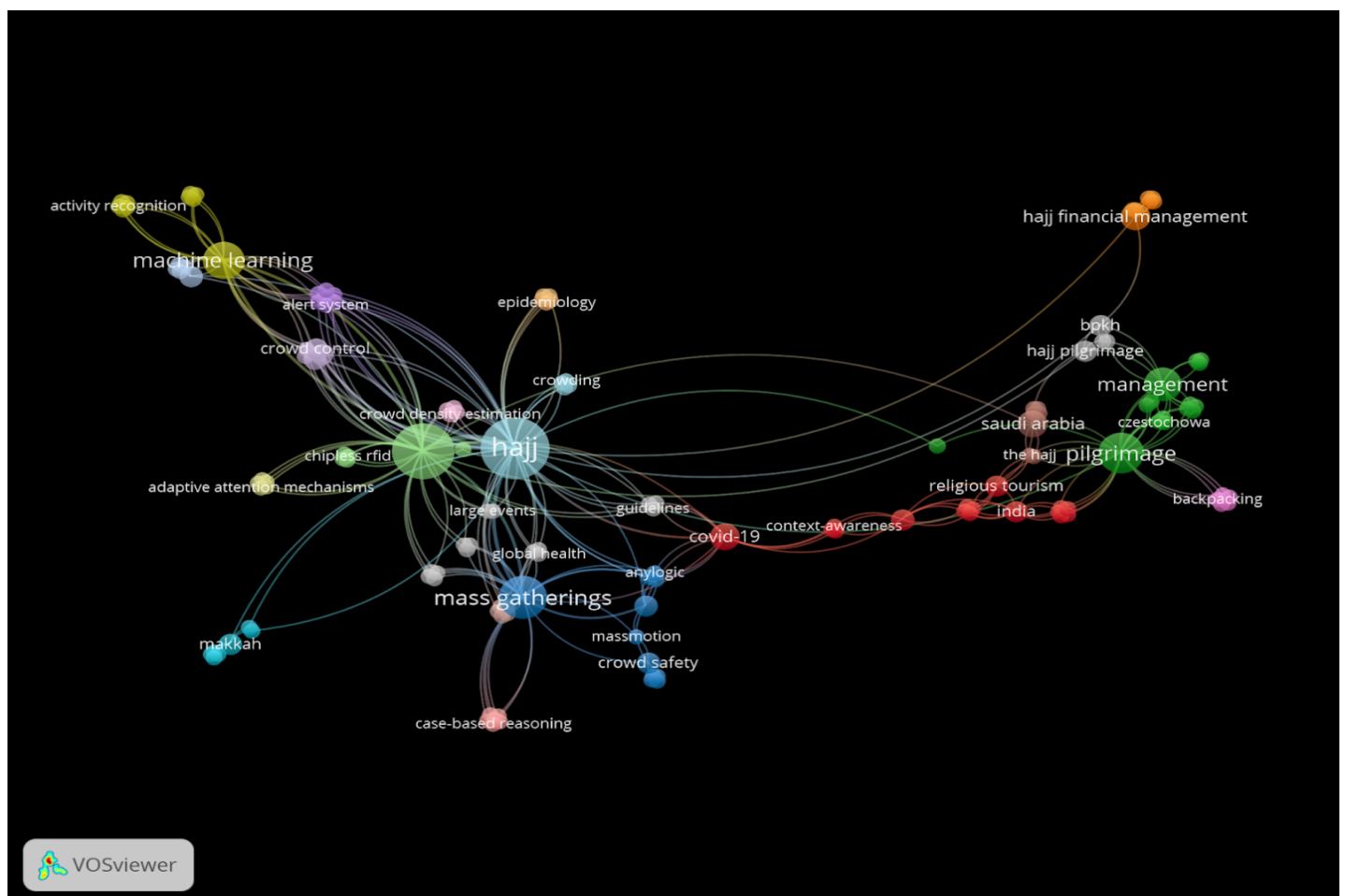
Source: Data retrieved from Scopus Database (<https://www.scopus.com>), accessed on 20 December 2025

The country-level distribution shown in Table 6 highlights a clear concentration of scholarly output in nations with direct religious, administrative, and demographic connections to the Hajj and Muslim pilgrimage. Saudi Arabia emerges as the leading contributor, accounting for 25.6% of the total publications, which is unsurprising given its central role as the host country responsible for planning, regulating, and managing the Hajj. The prominence of Saudi-based research reflects strong institutional involvement from governmental bodies, universities, and research centres that are directly engaged in addressing operational challenges such as crowd control, infrastructure development, public health preparedness, and policy implementation. This dominant position underscores the strategic importance of evidence-based research in supporting the continuous improvement of pilgrimage management at the source.

Beyond the host nation, significant contributions from Indonesia (14.6%) and Malaysia (9.8%) indicate the active engagement of major Muslim-majority countries with large pilgrim populations. Research output from these countries often focuses on pre-departure management, pilgrim education, health screening, and coordination with Saudi authorities, reflecting their institutional responsibilities in managing outbound pilgrims. Contributions from non-Muslim-majority countries such as the United Kingdom, United States, Canada, Australia, and Germany suggest a growing global academic interest in Hajj as a case study for mass gathering management, public health, and risk governance. However, the relatively uneven geographical distribution also points to potential gaps in cross-regional collaboration and underrepresentation of certain Muslim-majority regions. Overall, the findings demonstrate that leadership in Hajj and Muslim pilgrimage management research is shaped by a combination of geographical proximity, administrative responsibility, and academic capacity, aligning closely with the complexities involved in managing the world's largest religious gathering.

5. What are the most frequently occurring keywords and thematic clusters in the literature on Hajj and Muslim pilgrimage management?

Figure 5. Dominant Keywords and Thematic Focus in Hajj and Muslim Pilgrimage Management Studies.



Source: Author's Analysis using VOSviewer based on data retrieved from Scopus Database (<https://www.scopus.com>), accessed on 20 December 2025

The analysis of frequently occurring keywords and thematic clusters in the literature on Hajj and Muslim pilgrimage management reveals the multidimensional nature of managing the world's largest recurring religious gathering. Dominant keywords commonly cluster around themes such as crowd management, mass gatherings, Hajj, Umrah, public health, safety, and technology adoption, reflecting the core operational and managerial challenges faced by host authorities. The prominence of these terms indicates that scholarly attention has largely focused on mitigating risks associated with extreme crowd density, ensuring pilgrims' safety, and maintaining service efficiency. This emphasis aligns closely with the scale and complexity of the Hajj, where millions of pilgrims converge in a limited geographical area within a fixed time frame, making effective management a critical global concern.

In addition, emerging thematic clusters related to digital technologies, artificial intelligence, smart systems, and sustainability suggest a gradual shift in the literature from conventional administrative approaches toward data-driven and technology-enabled solutions. These clusters highlight how contemporary research increasingly frames pilgrimage management not only as a religious or logistical issue but also as a domain of innovation, resilience, and long-term planning. From a bibliometric perspective, the co-occurrence of traditional management themes with advanced technological concepts underscores an evolving research landscape that responds to both immediate operational demands and future-oriented governance challenges. This thematic evolution directly supports the study's objective of mapping intellectual trends in Hajj and Muslim pilgrimage management, demonstrating how the field has expanded to integrate interdisciplinary perspectives in addressing one of the world's most complex mass gatherings.

## DISCUSSION & CONCLUSION

This study set out to examine the scholarly landscape of Hajj and Muslim pilgrimage management through a bibliometric analysis. The main purpose was to identify publication trends, influential research contributions, dominant subject areas, leading countries, and prevailing thematic patterns that shape academic discussions on managing the world's largest religious gathering. The analysis was guided by research questions focusing on temporal growth, disciplinary contributions, geographic distribution, citation impact, and keyword-based thematic structures within the literature.

The findings reveal a clear upward trend in publications over the examined period, indicating growing academic attention to Hajj and Muslim pilgrimage management. Research output shows noticeable acceleration in recent years, reflecting increasing concerns related to crowd management, public health, sustainability, technology adoption, and governance in large-scale religious events. The subject area analysis demonstrates that social sciences form the core disciplinary foundation, complemented by significant contributions from engineering, computer science, medicine, and business-related fields. This pattern highlights the multidisciplinary nature of pilgrimage management research, where managerial, technological, and health-related perspectives intersect. Country-level analysis indicates that research output is led by nations with direct institutional, religious, or demographic connections to Hajj and pilgrimage activities, alongside contributions from developed research-intensive countries. Citation analysis further shows that highly cited works tend to focus on crowd management, religious tourism governance, technological solutions, and crisis management, underscoring their foundational role in shaping the field.

In terms of academic contribution, this study provides a structured overview of how research on Hajj and Muslim pilgrimage management has evolved and diversified. By mapping publication patterns, influential articles, and thematic clusters, the analysis clarifies the intellectual structure of the field and highlights areas that have received sustained scholarly attention. The identification of dominant keywords and thematic clusters also helps to explain how research priorities have shifted over time, particularly toward digital technologies, safety management, sustainability, and policy planning. These insights extend existing literature by offering an integrated, data-driven perspective on the development and maturity of this research domain.

The findings carry practical implications for policymakers, religious authorities, and event managers involved in pilgrimage organization. Understanding dominant research themes and influential studies can support evidence-based decision-making in areas such as crowd control, health preparedness, infrastructure planning, and the integration of digital technologies. The multidisciplinary nature of the literature suggests that effective



pilgrimage management requires coordinated approaches that combine social, technical, medical, and managerial expertise.

Despite its contributions, this study has certain limitations. The analysis relies on a single bibliographic database and focuses on English-language journal articles, which may exclude relevant studies published in other languages or indexed elsewhere. In addition, bibliometric methods emphasize quantitative patterns and may not fully capture contextual or qualitative nuances within individual studies. Future research could expand the scope by incorporating multiple databases, comparative regional analyses, or mixed-method approaches that combine bibliometric mapping with in-depth content analysis.

In conclusion, this bibliometric analysis demonstrates the value of systematic mapping in understanding research trends and knowledge structures in Hajj and Muslim pilgrimage management. By providing a comprehensive overview of publication dynamics, disciplinary contributions, and thematic orientations, this study offers a solid reference point for scholars and practitioners. Continued bibliometric and thematic investigations are essential to support the development of more integrated, resilient, and sustainable approaches to managing one of the most complex religious gatherings in the world

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