

Research Trends on Arabica Coffee: A Bibliometric Analysis

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Editor: Samuel Pereira de Carvalho

Received in April 12, 2025 and approved August 20, 2025

ABSTRACT

Coffee, one of the world's oldest and most popular drinks, has become a crucial agricultural commodity with significant economic, social, and environmental impacts. This study presents a comprehensive bibliometric analysis of Arabica coffee research, drawing from Scopus and Web of Science (WoS) databases from 1990 to 2024. Given Arabica coffee's economic, environmental, and socio-cultural significance, scholarly attention has intensified across multiple disciplines, yet an integrated overview of the field remains limited. This research addresses that gap by analysing 7,520 unique records using ScientoPy and VOSviewer to evaluate publication trends, productive institutions, leading journals, contributing countries, and co-occurrence of author keywords. The findings reveal a substantial increase in research output, particularly since 2015, with Brazil emerging as the most prolific country and the Universidade Federal de Lavras (UFLA) leading institutional contributions. While traditional journals continue to play a key role, newer outlets such as Foods and IOP Conference Series have seen notable recent activity. Keyword co-occurrence analysis identifies two broad thematic directions: established domains focused on plant pathology, biochemical composition (e.g., caffeine, chlorogenic acid), and genetics; and emerging themes including climate change adaptation, antioxidant activity, agroforestry, and quality-driven value chains. The study underscores a shift towards interdisciplinary, sustainability-oriented research driven by environmental challenges, market demands, and policy shifts. This analysis provides a robust platform for future research planning, identifying collaboration opportunities, and aligning academic inquiry with global development goals. Future directions include co-authorship and citation network analysis, policy impact studies, and exploring digital innovations in Arabica coffee production systems.

Key words: Arabica coffee; agroforestry; sustainable agriculture; functional beverages; good agricultural practices (GAP).

1 INTRODUCTION

Coffee is one of the world's oldest and most widely consumed beverages (Rodriguez Pabon et al., 2020), and it has evolved into a vital agricultural commodity with far-reaching economic, social, and environmental consequences (Syofya, 2023). The global coffee market has grown significantly in recent decades, driven by rising consumer demand, international trade, and intensifying production (Freitas et al., 2024). Among the various cultivated species, *Coffea arabica*, commonly known as Arabica coffee, commands particular importance due to its superior flavour profile, lower caffeine content, and higher market value (Omar et al., 2024). Predominantly grown in highland regions of Latin America, Africa, and Asia, Arabica coffee thrives under cool temperatures and high-altitude conditions (Krishnan, 2017). Beyond its commercial value, Arabica coffee supports the livelihoods of millions of smallholder farmers worldwide, for many of whom it represents a primary, if not sole, source of income (Kishaija et al., 2025).

Academic interest in Arabica coffee has surged in response to mounting concerns over climate change (Zhu et al., 2024), environmental degradation (Anhar et al., 2021), volatile commodity markets (Zhang; Saghaian; Reed, 2022), and socio-economic disparities in producing regions (Utrilla-Catalan et al., 2022). As the industry navigates growing calls for sustainable and climate-resilient production, research has proliferated across domains such as agronomy (Madrid-Casaca

et al., 2021), environmental science (Ahmed et al., 2021), food systems (Rodriguez-Camayo et al., 2024), and agricultural economics (Gizaw; Abafita; Merra, 2022). This growing body of multidisciplinary scholarship highlights the urgent need for integrated approaches to address the coffee sector's interlinked environmental, economic, and social challenges.

Climate change has emerged as a defining factor shaping the Arabica coffee research agenda. The species is especially vulnerable to climatic variation, with several studies predicting significant reductions in suitable growing areas under future warming scenarios (Mamuye et al., 2024). Increases in temperature and rainfall irregularity are linked to yield decline, compromised cup quality, and greater susceptibility to pests such as coffee leaf rust and coffee berry borer (Lemma; Abewoy, 2021). Consequently, recent research has focused on adaptation strategies, including agroforestry, climate-resilient cultivars, elevation shifts, and shade-grown systems.

One of the central themes in recent scholarship is the promotion and implementation of Good Agricultural Practices (GAP) in Arabica coffee cultivation. GAP refers to principles that ensure food safety, sustainability, and economic viability (Olaniran et al., 2023). Applied to coffee production, GAP includes integrated pest management, soil fertility enhancement, water efficiency, biodiversity protection, and labour rights (Ferrucho; Marín-Ramírez; Gaitan, 2024). Numerous studies have identified GAP as a promising pathway for improving smallholder farms' environmental and economic performance

(Gaitán-Cremaschi *et al.*, 2018). International certification schemes such as Fairtrade, Organic, Rainforest Alliance, and UTZ Certified have institutionalised sustainability through compliance with GAP standards (Chiputwa *et al.*, 2015).

Nonetheless, the diffusion of GAP remains limited in many regions, hindered by challenges including inadequate knowledge transfer and technical support (Tadesse *et al.*, 2020), high certification costs (Barreto Peixoto *et al.*, 2022), weak institutional frameworks (Córdoba *et al.*, 2023), and socio-cultural resistance among smallholders (Kiwelu *et al.*, 2021). Moreover, the impact of sustainability standards on actual farm-level outcomes remains contested, with mixed findings reported across different geographic and socio-economic contexts (Valbuena *et al.*, 2021; Woyesa; Kumar, 2021; Wright *et al.*, 2024). As such, the academic literature on Arabica coffee reflects the complexity of sustainability transitions and the dynamic interplay between environmental, economic, and social factors.

Despite the increasingly rich and diverse body of literature on Arabica coffee, a noticeable gap exists in comprehensive efforts to systematically map this research domain's structure, thematic evolution, and intellectual landscape. Existing reviews tend to concentrate on narrow subfields such as fermentation processes (Silva *et al.*, 2024), agronomic practices (Madrid-Casaca *et al.*, 2021), and chemical hazard assessments (Guadalupe *et al.*, 2024) without offering an integrated overview of the field. Although Abdelwahab *et al.* (2024) recently conducted a valuable bibliometric review on Arabica coffee using Scopus, their analysis was confined to a single database. This study addresses this gap by employing an integrated bibliometric approach using Scopus and Web of Science (WoS) data to provide a more holistic picture of Arabica coffee scholarship.

Accordingly, this study aims to:

1. Assess the growth trajectory of publications related to Arabica coffee
2. Identify the most productive institutions, source titles, and countries contributing to the field
3. Analyse the co-occurrence of keywords and thematic trends to uncover dominant and emerging areas of focus

2 MATERIAL AND METHODS

2.1 Database selection and visualisation techniques

The bibliometric data for this study were sourced from Scopus and WoS, two of the most comprehensive and internationally recognised multidisciplinary databases. These platforms were selected due to their extensive coverage of high-quality, peer-reviewed literature and the robustness of their bibliographic metadata (Abdullah; Sofyan, 2023), thereby ensuring the reliability and comprehensiveness of the present analysis.

Data collection was carried out in April 2025. A systematic search strategy was employed to refine the dataset, utilising Boolean operators (AND, OR) and wildcard characters. The search was conducted within the title, abstract, and keywords fields using the following search string: “Arabica coffee” OR “Coffea arabica” OR “Arabica bean”. This structured approach facilitated identifying relevant scholarly publications on Arabica coffee.

Bibliometric datasets were analysed for publication records in Scopus and WoS from 1990 to 2024. This time frame was selected to ensure a comprehensive longitudinal perspective on the evolution of scholarly output related to the research topic. The year 1990 was chosen as the starting point, as it marks a period of significant expansion in digital academic publishing, which allowed for more consistent indexing and bibliographic record-keeping in significant databases. Including data up to 2024 ensures that the most recent developments and emerging research trends are captured, thereby enhancing the relevance and timeliness of the bibliometric analysis.

As the study relied exclusively on publicly available bibliometric data, no human participants were involved, and ethical approval was not required. Nonetheless, all data handling and reporting adhered strictly to principles of academic integrity, including appropriate citation and transparent presentation of results.

Bibliometric analyses were performed using ScientoPy, an open-source, Python-based software designed to analyse research trends and generate bibliometric visualisations (Sofyan *et al.*, 2024). ScientoPy supports data imported from major scholarly databases, including Scopus and WoS, and enables the extraction and visualisation of key bibliometric indicators such as annual publication outputs, leading authors, influential journals, citation patterns, and the evolution of author keywords (Abdullah, 2023; Ruiz-Rosero *et al.*, 2019). ScientoPy was the primary analytical tool in this study, ensuring methodological consistency and precision in data processing, trend identification, and visual representation of research outputs.

The study also employed VOSviewer, a widely used software tool for constructing and visualising bibliometric networks to examine the co-occurrence of author keywords (Yang; Qu; Hua, 2022). Co-occurrence analysis helps to identify prominent research themes, conceptual structures, and the intellectual landscape of the field by mapping frequently used keywords and their interrelationships (Abdullah, 2021). VOSviewer was selected due to its capability to generate high-resolution, interactive visualisations, which facilitate the detection of clusters of related terms, emerging topics, and thematic shifts over time. This dual-tool approach combines ScientoPy's statistical trend insights with VOSviewer's network-based visual analysis, which ensures a more holistic and nuanced understanding of the field's knowledge structure and development trajectory.

2.2 Data screening, inclusion criteria, and preprocessing procedures

In order to uphold the credibility and thematic precision of the dataset, clearly defined inclusion and exclusion criteria were implemented throughout the selection process (Azizan; endrini; Abdullah, 2025). The study incorporated only peer-reviewed journal articles, conference proceedings, and review papers published in English, explicitly focusing on Arabica coffee research. Upon data retrieval, a rigorous preprocessing and data-cleaning procedure was undertaken to enhance the accuracy and consistency of the dataset (Baharom; Abdullah, 2024). This process began with identifying and removing duplicate records originating from both Scopus and WoS databases. The data were subsequently standardised to address discrepancies in author names, institutional affiliations, and journal titles. Additional filtering steps were applied to exclude articles not directly aligned with the study's thematic scope. Finally, a manual validation was conducted to verify the completeness and reliability of the final dataset used for bibliometric analysis.

Table 1 presents a comprehensive overview of the dataset collection and deduplication process. Approximately 11404 documents were retrieved from Scopus and WoS databases. Following the exclusion of 330 documents based on irrelevant categories (2.90%), a refined dataset of 11074 papers remained for further processing. Of these, 45.40% (5027) were sourced from WoS and 54.60% (6047) from Scopus. A deduplication check identified 3554 duplicate records (32.10%) across the two databases. Duplicates were removed primarily from Scopus (2784 records, 46.00%) and, to a lesser extent, from WoS (770 records, 15.30%) based on citation strength and metadata completeness. Notably, 71.20% (2532) of the duplicated records exhibited varying citation counts, underscoring the need for careful validation during the deduplication process.

After removing duplicates, the final dataset comprised 7520 unique records, with 4257 (56.60%) retained from WoS and 3263 (43.40%) from Scopus. This thorough screening and cleansing process ensured a high-quality, non-redundant dataset suitable for robust bibliometric analysis. According to bibliometric standards and previous methodological literature (Donthu et al., 2021), a dataset comprising more than 300 records is generally acceptable for generating meaningful insights into publication trends, author productivity, citation impact, and research themes. Therefore, the final dataset of 7520 records provides a robust foundation for ensuring the reliability and depth of the bibliometric analysis in this study.

3 RESULTS

3.1 Growth trajectory of publications

Figure 1 illustrates the annual publication trends for Arabica coffee-related research indexed in WoS and Scopus between 1990 and 2024. In the early 1990s, research activity was relatively modest, with fewer than 60 publications per year in either database. Both databases recorded a gradual increase in output, with WoS consistently maintaining a slightly higher number of indexed documents. A noticeable growth phase began in the early 2000s, coinciding with the increasing global awareness of coffee's economic, agricultural, and environmental significance. This period was marked by critical shifts in the international coffee trade, particularly following the collapse of the International Coffee Agreements (ICAs) and the liberalisation of commodity marketing systems in many developing countries. As Pancsira (2022) notes, these structural transformations sparked broader discussions around the volatility of coffee prices, smallholder vulnerability, and the need for policy reforms in production and trade mechanisms.

Table 1: Dataset overview and deduplication process.

Information	Number	Percentage
Initial papers (Scopus and WoS)	11404	
Excluded documents by category	330	2.90%
Total papers following the exclusion of omitted papers	11074	
Record papers from WoS	5027	45.40%
Record papers from Scopus	6047	54.60%
Duplicated papers found	3554	32.10%
Removed duplicated papers from WoS	770	15.30%
Removed duplicated papers from Scopus	2784	46.00%
Duplicated documents with varying citations by	2532	71.20%
Total papers after the elimination of duplication	7520	
Record papers from WoS	4257	56.60%
Record papers from Scopus	3263	43.40%

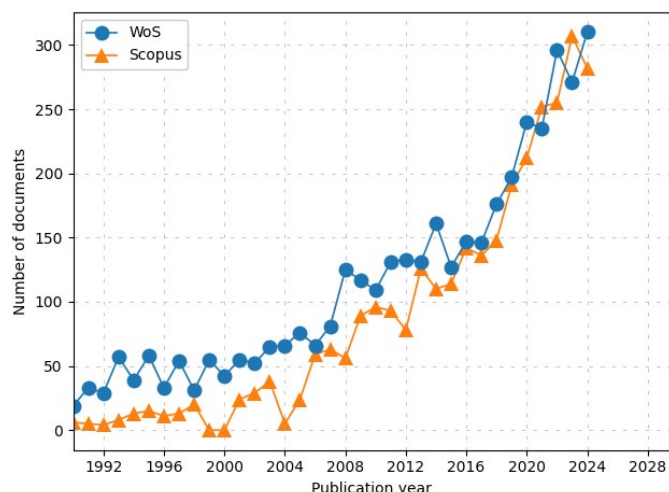


Figure 1: Growth trajectory of publications.

The inflexion point emerged around 2007 when a sharp upward trajectory became evident. WoS recorded 125 publications in 2008, compared to just 63 in Scopus, highlighting the earlier expansion of WoS indexing. From 2015 onwards, the annual volume of publications accelerated in both databases, with outputs surpassing 200 documents per year from 2020 onward. Most publications were recorded in 2024, with 310 documents in WoS and 282 in Scopus, indicating a sustained and intensified scholarly interest in the topic.

This surge in output aligns with increasing research on climate resilience, sustainable agriculture, and the socio-economic value of coffee cultivation, particularly Arabica, which is renowned for its quality and sensitivity to climatic conditions (Bilen et al., 2022; Cassamo et al., 2023). Moreover, integrating digital technologies in agriculture and the emergence of interdisciplinary studies have likely contributed to this growth trend (Sott et al., 2020). The consistent upward trend across both databases also reflects the internationalisation of research, the expansion of open-access publishing, and the inclusion of more journals in significant indexing platforms over time. The convergence of document counts in both databases in recent years, particularly from 2021 to 2024, further suggests harmonisation in journal coverage and database indexing standards.

3.2 Productive institutions, source titles, and countries

Figure 2 illustrates the top ten most productive institutions contributing to scholarly publications on Arabica coffee. The data reveal that research on Arabica coffee is concentrated within a few specialised institutions, many of which are in countries with significant coffee production economies, particularly Brazil, France, and Ethiopia.

The Universidade Federal de Lavras (UFLA), Brazil, emerged as the most prolific institution, contributing a

total of 305 publications. This is followed by Universidade Federal de Viçosa, also in Brazil, with 226 publications, and Universidade de São Paulo with 99 publications. Interestingly, UFLA appears again under a slightly different institutional name format (“Univ Fed Lavras UFLA”), contributing an additional 91 publications, possibly due to inconsistencies in institutional metadata across databases, a common challenge in bibliometric analyses (Abdullah; Sofyan, 2023).

Outside Brazil, notable contributions came from CIRAD (France) with 76 publications, and Jimma University (Ethiopia) with 72 publications, highlighting the global nature of Arabica coffee research and the importance of both producer and development-focused research institutions. Université de Montpellier (France) also featured prominently with 64 publications, further reinforcing France’s strong research presence in agricultural and tropical crop sciences.

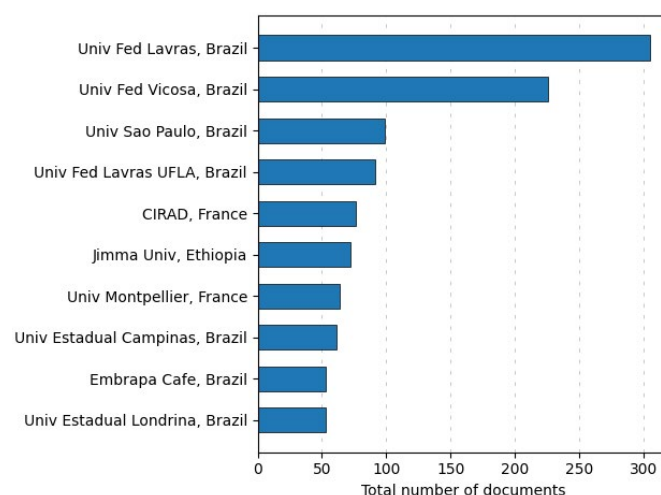


Figure 2: Productive institutions.

Brazil’s dominance is consistent with its status as the world’s largest producer and exporter of Arabica coffee (Volsi et al., 2019), which explains the substantial research investment in improving productivity, quality, disease resistance, and sustainable farming practices. The presence of institutions such as Embrapa Café, which operates under Brazil’s national agricultural research agency, and other state universities underscores the strategic national importance of coffee research in Brazil.

The appearance of institutions from Ethiopia, the centre of origin for *Coffea arabica*, reflects a growing scholarly interest in genetic diversity, conservation, and the socio-economic roles of coffee cultivation in African contexts (Legesse, 2020). France’s presence, notably through CIRAD and the University of Montpellier, indicates its ongoing collaboration in tropical agricultural research and global development partnerships.

The distribution of institutional productivity suggests that collaborative networks between research institutions in

the Global South and North are instrumental in advancing the scientific understanding of Arabica coffee. This insight sets the stage for deeper co-authorship and collaboration analyses in the following sections.

Figure 3 presents the top ten source titles contributing to disseminating Arabica coffee research. The findings reflect a strong orientation towards agricultural, food science, and environmental journals, with several sources showing increased publishing activity in the most recent two years (2023–2024), highlighting ongoing scholarly interest in this field.

The most prolific journal is *Coffee Science*, with 389 publications representing a dedicated outlet for coffee-related research. However, only 8% of its total publications were produced in the last two years, suggesting a stable but gradually declining contribution in recent times. This may indicate a maturation of the journal's focus or increasing competition from more generalists or interdisciplinary journals.

IOP Conference Series: Earth and Environmental Science ranks second with 152 publications, of which a significant 35% were published in 2023 and 2024. This highly recent output reflects the growing importance of conference-based dissemination and the relevance of Arabica coffee research within environmental and sustainability discourses.

Ciencia e Agrotecnologia, despite being the third most productive source with 143 articles, reported no publications in the past two years, indicating either a shift in editorial focus or reduced submissions in the Arabica coffee domain. Prestigious international journals such as *Food Chemistry* (138 articles) and the *Journal of Agricultural and Food Chemistry* (112 articles) have maintained their relevance, albeit with lower recent output (10% and 4%, respectively), likely due to their broad disciplinary coverage. These journals underscore coffee research's chemical, nutritional, and processing dimensions.

Of particular note is the journal *Foods*, which has shown the highest recent activity, with 48% of its 62 articles published in 2023–2024. This indicates an emerging outlet for current and rapidly evolving studies, particularly those that intersect with human health, functional food applications, and sensory sciences. Other notable contributors include *Food Research International* (64 publications; 25% recent) and *Agroforestry Systems* (59 publications; 14% recent), reflecting a broader interest in integrating coffee into agroecological systems and global food research narratives.

The data highlights a diverse publication landscape, where dedicated coffee journals coexist with broader, interdisciplinary outlets. The increased activity in specific journals over the past two years suggests a renewed academic interest, possibly fuelled by growing concerns over climate change, sustainability, and consumer demand for speciality coffee. This trend offers valuable guidance for researchers seeking high-impact platforms for disseminating findings and reflects Arabica coffee research's shifting thematic and disciplinary focus.

Figure 4 presents a dual-panel visualisation of Arabica coffee-related publications' evolution and recent momentum across the top ten most productive countries. The left panel shows the cumulative number of publications from 1990 to 2024, while the right panel plots the average number of documents published per year in 2023–2024 against the percentage of publications from those two years relative to each country's total output.

Unsurprisingly, Brazil dominates the global research landscape, with an exponential growth trajectory far surpasses all other countries, reaching nearly 2,700 cumulative publications by 2024. This trend underscores Brazil's dual role as the largest global producer of Arabica coffee and a leading contributor to coffee-related scientific research (Volsi et al.,

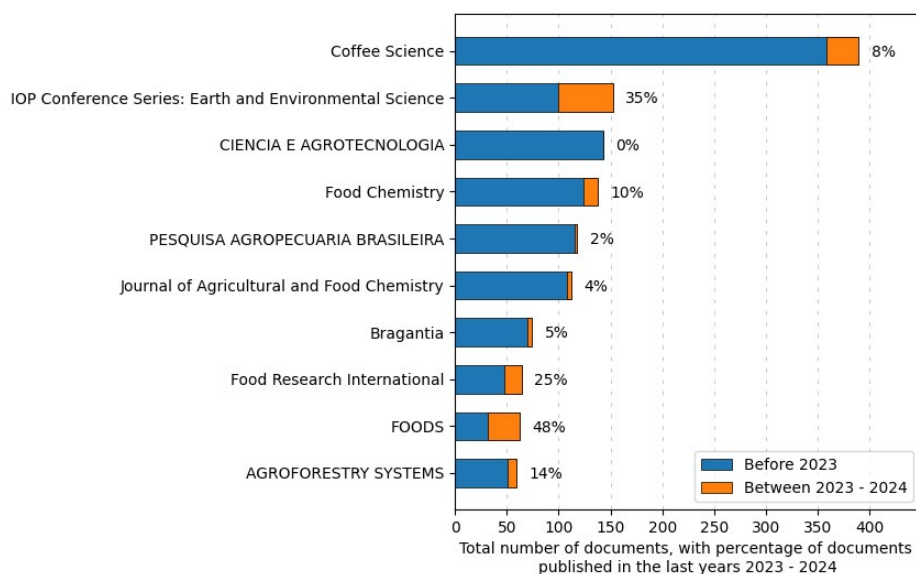


Figure 3: Productive source titles.

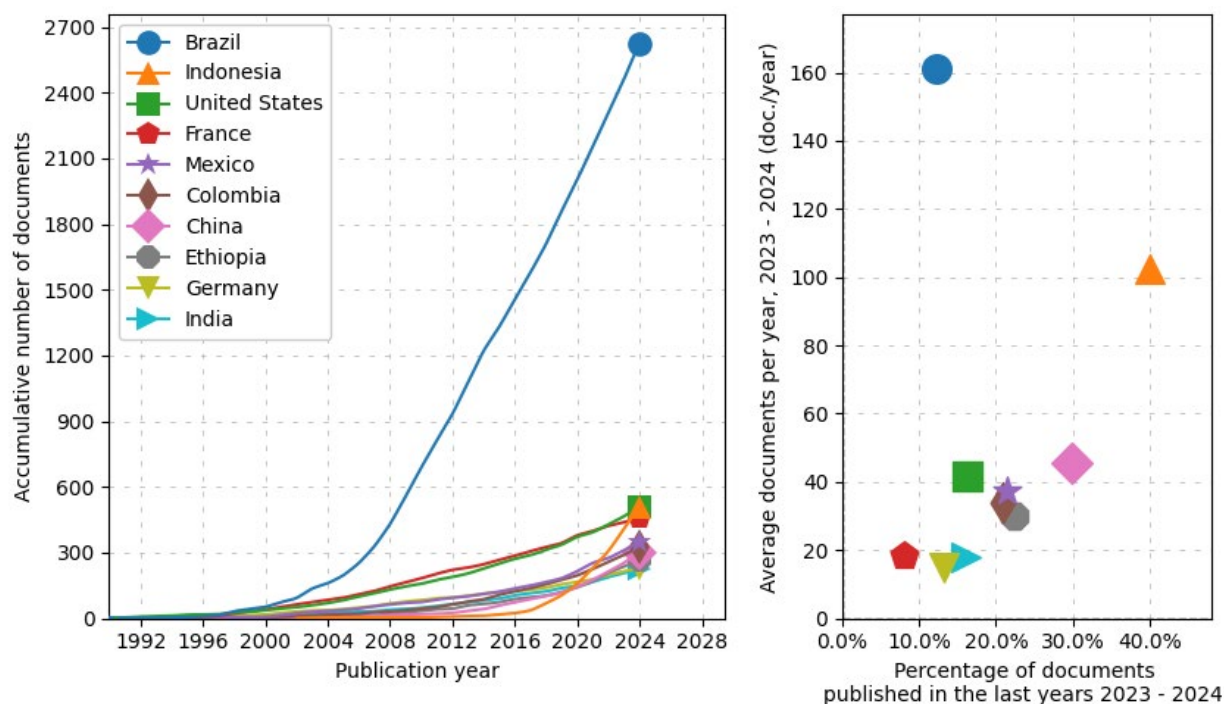


Figure 4: Most productive countries.

2019). Brazil also maintains the highest average annual output in the last two years (2023–2024), at over 160 documents per year, indicating sustained investment and scholarly productivity in this domain.

Although trailing far behind Brazil in total volume, Indonesia has emerged as the most rapidly accelerating contributor in recent years, with more than 40% of its total output published in just 2023 and 2024 and an average of over 100 publications per year. This surge suggests a growing academic mobilisation in Indonesia around coffee science, likely driven by its status as a significant coffee-producing nation and increasing governmental and academic interest in sustainable agriculture, export economies, and agri-technology (Suratman et al., 2024).

Countries such as the United States, France, and Mexico show moderate cumulative outputs (between 300–600 documents) with a relatively balanced distribution of publications over time. These nations have consistently supported coffee research (Pelupessy, 2007), often from a consumption, processing, biotechnology, and food sciences perspective. Colombia, China, Ethiopia, and Germany exhibit steady but less pronounced growth, each contributing between 100 and 300 documents cumulatively. In Ethiopia, the botanical origin of *Coffea arabica* is notable for its steady academic engagement, which is likely focused on genetic diversity, indigenous farming practices, and conservation strategies (Melese; Kolech, 2021).

The right panel also highlights countries with a high percentage of recent publications, which can be interpreted

as an indicator of emerging or re-emerging research intensity. Apart from Indonesia and Brazil, China and India demonstrate an upward shift in research output between 2023 and 2024, reflecting an increasing interest in coffee cultivation, market expansion, and agro-industrial innovation in Asian economies. The country-level analysis reveals two parallel dynamics: Brazil’s long-standing institutional and scientific leadership and a notable surge in research activity from emerging economies, especially in Asia. This shift reflects the globalisation of Arabica coffee research, increasingly driven by factors such as climate adaptation, export competitiveness, and food security policies in the Global South.

3.3 Co-occurrence of keywords and thematic trends

In order to gain insight into the conceptual structure of Arabica coffee research, a keyword co-occurrence analysis was conducted using VOSviewer, applying a minimum threshold of 50 keyword occurrences, resulting in a network of 33 widespread keywords. Figure 5 presents the overlay visualisation of the co-occurrence network, while Figure 6 provides a bar graph of selected keywords and the proportion of publications in which they appeared between 2023 and 2024.

The most dominant keywords, as indicated by node size and centrality in Figure 5, include “*Coffea arabica*”, “coffee”, “caffeine”, “Arabica coffee”, and “chlorogenic acid”. These terms represent long-standing, foundational topics within the field of coffee research. Their prominence is consistent with

the established role of Arabica coffee as the most widely consumed and economically valuable coffee species globally (Pancsira, 2022). As shown in Figure 6, “*Coffea arabica*” appeared in the highest number of documents overall; however, only 12% of these publications were produced in 2023–2024, suggesting that this research area has reached a stage of maturity and conceptual stabilisation. Similarly, “caffeine” and “chlorogenic acid”, two well-known bioactive compounds in coffee, continue to feature prominently in the literature. Their moderate recent publication rates (15% and 12%, respectively) indicate sustained scientific interest, particularly concerning chemical composition, health functionality, and processing impacts, as highlighted in prior studies examining coffee’s phytochemical properties and nutritional significance (Mostafa et al., 2021). The persistent relevance of these keywords demonstrates their centrality to biochemical, agronomic, and consumer-focused inquiries in the Arabica coffee research domain.

In contrast, keywords such as “Arabica coffee”, “roasting”, “agroforestry”, and “antioxidant activity” reveal emerging thematic orientations. Notably, “Arabica coffee” shows a more recent rise in scholarly attention, with 17% of related articles published between 2023 and 2024. This indicates a shift from generic references to species-specific and industry-relevant discourse. The growing academic interest in Arabica coffee is also tied to its unique biochemical profile, sensory attributes, and vulnerability to climate stressors, features that increasingly position it at the centre of discussions on sustainable cultivation and market competitiveness (Getahun et al., 2024). Furthermore, “antioxidant activity” exhibits the highest proportion of recent publications (25%), suggesting growing interest in the bioactive and health-promoting properties of Arabica-derived compounds particularly relevant within food science and functional beverage research (Chan et al., 2022).

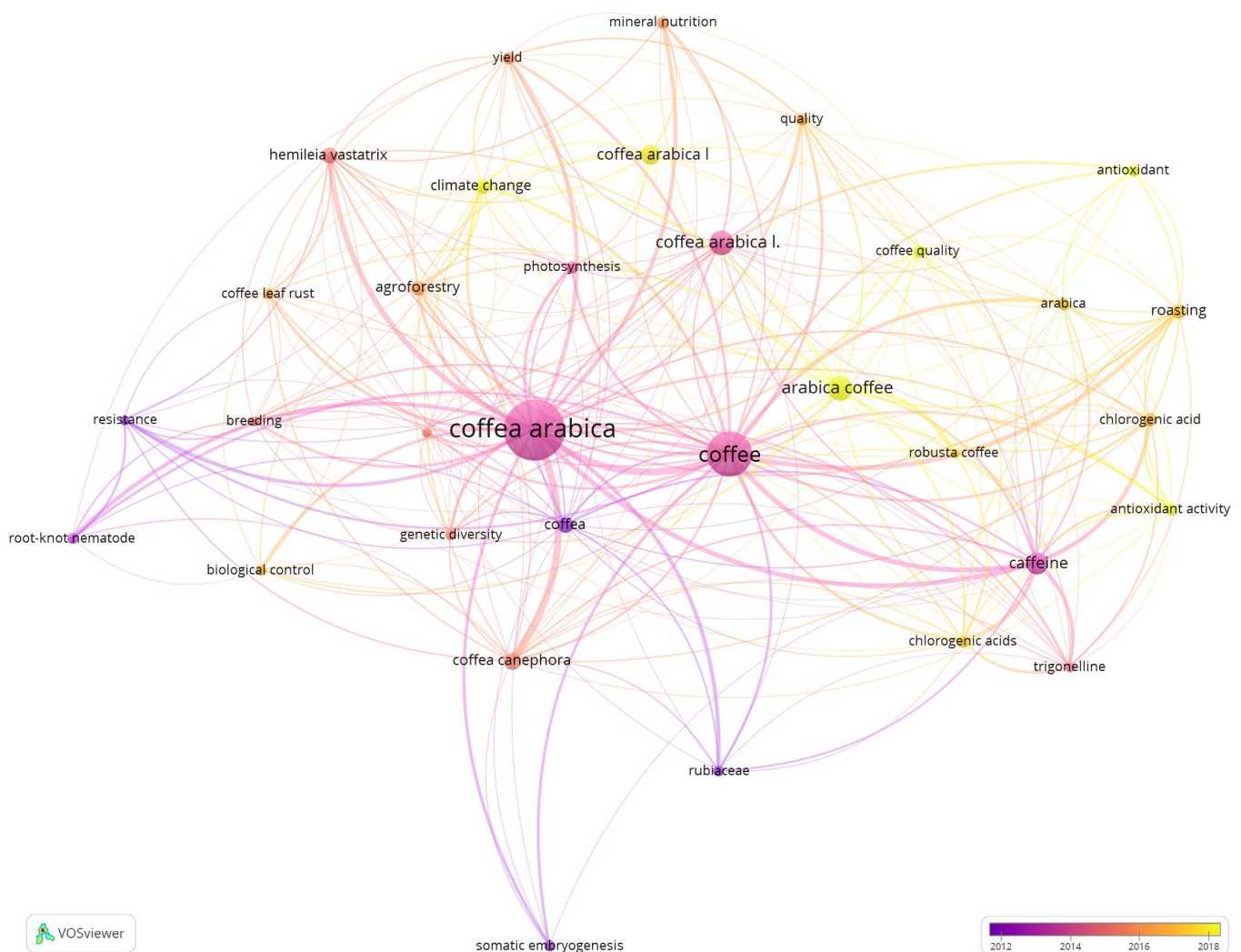


Figure 5: The overlay visualisation of the co-occurrence of authors' keywords.

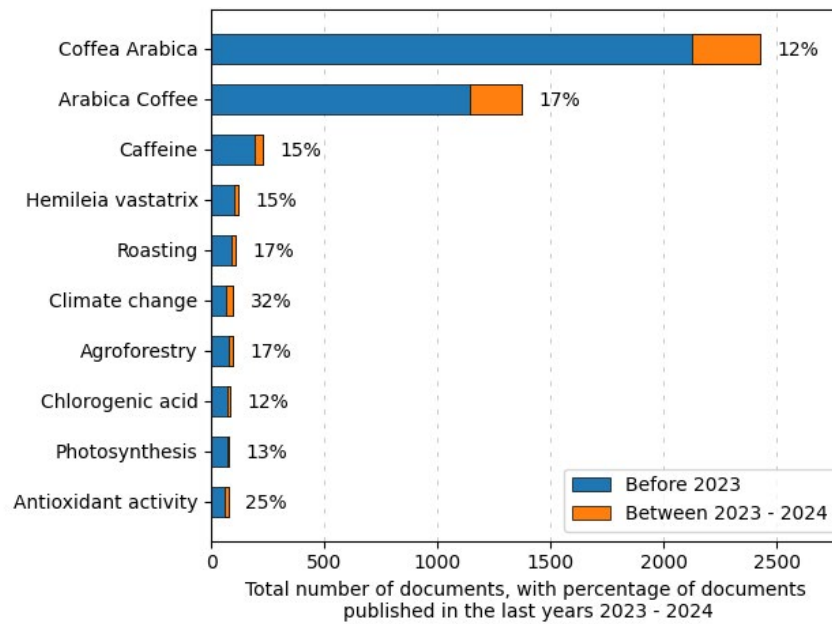


Figure 6: The top ten most used keywords.

A distinct thematic strand is represented by agronomic and ecological keywords such as “climate change” (32% recent publications), “photosynthesis” (13%), and “agroforestry” (17%), which underscore the field’s response to environmental challenges. The prominence of “climate change” and its strong co-occurrence with “yield”, “quality”, and “Coffea arabica” in Figure 5 signals a research pivot towards sustainability, climate adaptation, and ecosystem services in Arabica coffee cultivation (Ndiritu et al., 2021). This aligns with global agricultural agendas concerned with crop resilience, biodiversity conservation, and socio-environmental justice in coffee-producing regions (Aguilar-Rivera, 2024).

Keywords related to plant pathology and breeding, such as “*Hemileia vastatrix*” (coffee leaf rust), “resistance”, “biological control”, and “breeding” remain important, though their recent publication activity is comparatively modest (15–17%). These terms are predominantly associated with genetic improvement, pest management, and the ongoing battle against coffee diseases, indicating the continued importance of agronomic challenges, albeit with a more stable research momentum (Naik et al., 2021).

The co-occurrence and temporal analysis of author keywords highlights two broad thematic directions in Arabica coffee research:

1. Dominant and established areas: chemical composition (e.g., caffeine, chlorogenic acid), plant pathology, and genetic studies, with relatively stable output.

2. Emerging areas of focus: climate change adaptation, functional food potential (e.g., antioxidant activity), sustainability (e.g., agroforestry), and value chain quality enhancement (e.g., roasting).

These insights provide a nuanced understanding of how Arabica coffee research has evolved from production-oriented and taxonomic studies to a more interdisciplinary, sustainability, and consumer-driven focus, particularly in recent years.

4 DISCUSSION

The observed growth trajectory of Arabica coffee-related publications reveals a multi-phased evolution in the scholarly community’s engagement with this topic. The modest publication output during the 1990s can be attributed to limited research visibility and constrained institutional capacities in many coffee-producing countries. However, the early 2000s marked a discernible turning point, correlating with broader structural transformations in the global coffee sector. These included the collapse of the International Coffee Agreements (ICAs), the liberalisation of trade regimes, and increased volatility in coffee prices, all of which heightened scholarly interest in issues of smallholder vulnerability, supply chain governance, and global commodity dynamics (Pancsira, 2022). This period coincided with the rise of development-oriented agricultural research agendas, particularly within the Global South. The sharp increase in publications from 2007 onward, with a pronounced surge from 2015, aligns with growing attention to climate resilience, sustainable farming systems, and environmental externalities. These concerns have increasingly positioned Arabica coffee as a symbolic and strategic crop within climate change discourses and global food security frameworks (Bilen et al., 2022; Cassamo et al., 2023).

Institutional productivity data underscore the dominance of Brazilian academic and research institutions, which mirrors Brazil's geopolitical role as the most significant global producer and exporter of Arabica coffee (Volsi et al., 2019). Universities such as Universidade Federal de Lavras and Universidade Federal de Viçosa have established themselves as central nodes in producing scientific knowledge on coffee. Their sustained output reflects national investment in agricultural innovation and export-oriented research. However, inconsistent institutional naming conventions in databases, such as variants of UFLA, illustrate persistent metadata challenges in bibliometric research (Abdullah; Sofyan, 2023). Notably, the presence of CIRAD (France), Jimma University (Ethiopia), and Université de Montpellier highlights the enduring strength of North-South research collaborations. France's engagement in tropical agriculture, often through development partnerships, and Ethiopia's role as the genetic origin of *Coffea arabica* offer complementary scientific and geopolitical dimensions. These institutions contribute to the genomic and agronomic literature and socio-ecological studies on biodiversity conservation, traditional knowledge, and farmer resilience (Legesse, 2020).

Research distribution across journals indicates field-specific concentration and increasing thematic diversification. While Coffee Science remains the most prolific outlet, its declining proportion of recent publications suggests a potential plateau in its thematic scope or competitive positioning. In contrast, the rise of the IOP Conference Series and Foods reflects an emergent shift towards more interdisciplinary dissemination, especially in environmental sciences, food functionality, and health-related research. Nearly half of the publications in Foods occurred in the last two years, demonstrating the journal's responsiveness to evolving interests in nutrition, antioxidant profiling, and consumer health domains where Arabica coffee is gaining growing relevance. Journals such as Food Chemistry and Agroforestry Systems indicate increasing interest in coffee's biochemical and ecological integration into broader food systems. This diversification of source titles also reflects the maturation of coffee research, which has expanded beyond niche agronomic fields into broader scientific conversations about sustainability, human health, and agroecological design.

Brazil's unparalleled dominance in publication output reaffirms its long-standing position as a scientific and agricultural leader in the coffee sector. However, the steep rise in recent outputs from Indonesia, China, and India is particularly noteworthy. Indonesia's trajectory, with over 40% of its publications appearing from 2023 to 2024, signals a robust national push towards agricultural modernisation and agri-technological research, likely tied to policy incentives and academic-industry linkages (Suratman et al., 2024). Similarly, China's and India's increasing contributions

reflect a strategic pivot towards high-value agriculture and global value chain participation. These trends underscore a broader globalisation of coffee research, characterised by the decentralisation of scholarly production and a rise in regionally embedded yet globally oriented research efforts. The emergence of new research economies suggests that coffee science is increasingly driven by a complex interplay of climatic realities, economic aspirations, and academic investments in the Global South.

The keyword co-occurrence analysis reveals Arabica coffee research's layered and evolving conceptual structure. Foundational themes such as "*Coffea arabica*", "caffeine", and "chlorogenic acid" remain central, indicating continued interest in the plant's biochemical and agronomic properties (Mostafa et al., 2021). However, the relatively low percentage of recent publications in these categories suggests that these areas have reached a state of thematic saturation or conceptual maturity. In contrast, emerging keywords such as "climate change", "antioxidant activity", and "agroforestry" point to a dynamic reorientation towards interdisciplinary and application-driven studies. The prominence of "climate change" and its co-occurrence with terms like "yield" and "quality" reflects the field's alignment with climate-smart agriculture, ecosystem services, and adaptive farming strategies (Ndiritu et al., 2021). Similarly, the rise of "antioxidant activity" and "functional food" applications signifies a convergence of coffee science with consumer health and wellness narratives, expanding the field's relevance within nutritional science and public health (Chan et al., 2022). Keywords such as "roasting" and "sensory analysis" signal renewed scholarly interest in value chain enhancement, quality control, and consumer perception, which are critical for developing premium and speciality coffee markets. Meanwhile, enduring but stabilised interest in terms such as "*Hemileia vastatrix*" and "breeding" underscores the importance of plant disease resistance and genetic improvement. However, molecular and genomic approaches may now complement these.

5 CONCLUSIONS

This bibliometric analysis examines global Arabica coffee research from 1990 to 2024, utilising data from Scopus and WoS. It delineates publication trends, productive institutions, and nascent subjects. Results indicate steady expansion and diversification of topics, with Brazil leading the way in production and witnessing increasing contributions from Indonesia, China, and India. Current research encompasses genetics, chemistry, climate adaptability, sustainability, and quality. The study directs future collaboration, policy alignment, and technological integration to improve sustainable practices and global research involvement in Arabica coffee.

6 ACKNOWLEDGEMENTS

The author gratefully acknowledges the research funding support from the Directorate of Research and Community Service (DPPM), Directorate General of Higher Education, Ministry of Education and Culture of the Republic of Indonesia, through a 2025 research grant under contract number 122/C3/DT.05.00/PL/2025.

7 AUTHORS' CONTRIBUTION

Conceptual Idea: Nora, S.; Kuswardani, R.A.; Methodology design: Abdullah, K.H.; Nora, S.; Data collection: Mawardi, S.; Data analysis and interpretation: Abdullah, K.H.; Nora, S., and Writing and editing: Nora, S.; Kuswardani, R.A.; Mawardi, S.

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