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SCIENTIFÍC OVERVIEW OF *EUCALYPTUS* CULTIVATION IN TOCANTINS: A BIBILIOMETRIC ANALYSIS OF SCIENTIFÍC PRODUCTION

PANORAMA CIENTIFICO DO CULTIVO DE EUCALIPTUS NO TOCANTINS: UMA ANÁLISE BIBLIOMÉTRICA DA PRODUÇÃO CIENTÍFICA

PANORAMA CIENTÍFICO DEL CULTIVO DE EUCALIPTO EM TOCANTINS: UM ANÁLISIS BIBLIOMÉTRICO DE LA PRODUCCIÓN CIENTIFICA

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Abstract

This study aimed to analyze the scientific landscape of research on the cultivation and management of *Eucalyptus* from 1986 to 2026. The findings indicate that *Eucalyptus* production plays a strategic role in Brazilian forestry, particularly in tropical regions and within the Cerrado biome, where forest plantations contribute substantially to the supply of timber, biomass, and raw materials for the pulp and energy sectors. However, environmental constraints, including highly weathered soils, climatic variability, and recurrent periods of water deficit, may limit plantation growth and productivity, thereby requiring management practices and genetic improvement strategies capable of enhancing both productivity and the sustainability of these forest systems. A quantitative, descriptive, and exploratory bibliometric review was conducted in accordance with PRISMA guidelines. Data were collected from the Scopus database using descriptors related to *Eucalyptus* cultivation and silviculture within the TITLE-ABS-KEY field. The initial search retrieved 37.767 records, which were subsequently reduced to 1.006 documents after thematic and geographical refinement. Following the removal of duplicates and the application of eligibility criteria based on the screening of titles, abstracts, and full texts, the final dataset comprised 28 scientific articles. The results reveal a steady increase in scientific output over recent decades, with a marked concentration of publications in journals specializing in forest sciences, particularly Forest Ecology and Management. The findings also point to the strong leadership of Brazilian institutions and the consolidation of international research networks, accentuate the global relevance of studies focused on productivity, management, and sustainability in *Eucalyptus* plantations.

Keywords: Forest plantations; silviculture; Brazilian Cerrado; bibliometric analysis.

Resumo

O presente artigo teve como objetivo analisar o panorama da produção científica relacionada ao cultivo e manejo de *Eucalyptus* no período de 1986 a 2026. Verificou-se que a produção de *Eucalyptus* desempenha papel estratégico na silvicultura brasileira, especialmente em regiões tropicais e no bioma Cerrado, onde as plantações florestais contribuem significativamente para a produção de madeira, biomassa e matéria-prima para a indústria de celulose e energia. Entretanto, fatores ambientais como solos altamente intemperizados, variações climáticas e períodos recorrentes de déficit hídrico podem limitar o crescimento e a produtividade das plantações, exigindo estratégias de manejo e melhoramento genético capazes de aumentar a eficiência produtiva e a sustentabilidade desses sistemas florestais. Foi realizada uma revisão bibliométrica de natureza quantitativa, descritiva e exploratória, seguindo as diretrizes do protocolo PRISMA. A coleta de dados foi realizada na base Scopus, utilizando descritores relacionados ao cultivo e à silvicultura de *Eucalyptus* no campo *TITLE-ABS-KEY.* A busca inicial resultou em 37.767 registros, que após refinamento temático e geográfico foram

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reduzidos para 1.006 documentos. Após a remoção de duplicidades e aplicação de critérios de elegibilidade por meio da leitura de títulos, resumos e textos completos, o corpus final foi composto por 28 artigos científicos. Os resultados evidenciam crescimento progressivo da produção científica ao longo das últimas décadas, com maior concentração de publicações em periódicos especializados em ciências florestais, destacando-se *Forest Ecology and Management*. Conclui-se pelo forte protagonismo de instituições brasileiras e da consolidação de redes internacionais de pesquisa, evidenciando a relevância global dos estudos sobre produtividade, manejo e sustentabilidade das plantações de *Eucalyptus*.

Palavras-chave: Plantações florestais; Silvicultura; Cerrado brasileiro; Análise bibliométrica.

Resumen

El presente estudio tuvo como objetivo analizar el panorama de la producción científica relacionada con el cultivo y manejo de *Eucalyptus* en el período de 1986 a 2026. Se verificó que la producción de *Eucalyptus* desempeña un papel estratégico en la silvicultura brasileña, especialmente en regiones tropicales y en el bioma Cerrado, donde las plantaciones forestales contribuyen significativamente a la producción de madera, biomasa y materia prima para la industria de celulosa y energía. Sin embargo, factores ambientales como suelos altamente intemperizados, variabilidad climática y períodos recurrentes de déficit hídrico pueden limitar el crecimiento y la productividad de las plantaciones, lo que exige estrategias de manejo y mejoramiento genético capaces de aumentar la eficiencia productiva y la sostenibilidad de estos sistemas forestales. Se realizó una revisión bibliométrica de carácter cuantitativo, descriptivo y exploratorio, siguiendo las directrices del protocolo PRISMA. La recolección de datos se llevó a cabo en la base Scopus, utilizando descriptores relacionados con el cultivo y la silvicultura de *Eucalyptus* en el campo TITLE-ABS-KEY. La búsqueda inicial arrojó 37.767 registros, que, tras el refinamiento temático y geográfico, se redujeron a 1.006 documentos. Posteriormente, después de la eliminación de duplicados y la aplicación de criterios de elegibilidad mediante la lectura de títulos, resúmenes y textos completos, el corpus final estuvo conformado por 28 artículos científicos. Los resultados evidencian un crecimiento progresivo de la producción científica en las últimas décadas, con una mayor concentración de publicaciones en revistas especializadas en ciencias forestales, destacándose Forest Ecology and Management. Se concluye que existe un fuerte protagonismo de instituciones brasileñas y una consolidación de redes internacionales de investigación, lo que evidencia la relevancia global de los estudios sobre productividad, manejo y sostenibilidad de las plantaciones de *Eucalyptus*.

Palabras Clave: Plantaciones forestales; Silvicultura; Cerrado brasileño; Análisis bibliométrico.

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1. Introduction

The genus Eucalyptus has a significant impact on global forestry, being widely used for the production of pulp, solid wood, biomass, and bioenergy. In Brazil, Eucalyptus plantations exhibit high levels of productivity, resulting from the combination of favorable edaphoclimatic conditions, genetic improvement, and intensive silvicultural management (Colodette et al., 2014; Oliveira et al., 2025; Sanhueza-Novoa et al., 2026). The interaction among genetic, climatic, and management factors directly influences the development and productivity of plantations, especially in tropical and subtropical environments (Binkley et al., 2017; André et al., 2021; Rodrigues, Silva, & Nouvellon, 2021).

In this context, a large proportion of commercial plantations are established in the Brazilian Cerrado, a region characterized by highly weathered, nutrient-poor soils and seasonal rainfall regimes with periods of water deficit (Zinn, Resck, & Silva, 2002; Maquère et al., 2009). Under these conditions, factors such as water availability, soil fertility, and planting density become critical determinants of silvicultural performance (Fernandez et al., 2000; Elli et al., 2019; Hakamada et al., 2023). Ecophysiological studies indicate that water limitations can reduce photosynthetic efficiency and alter carbon balance, thereby compromising tree growth (Hubbard et al., 2010; Hubbard et al., 2020; Christina et al., 2023).

In this context, strategies such as nutrient management, selection of more adapted clones, and efficient water use have been widely investigated as alternatives to sustain forest plantation productivity under restrictive environmental conditions (Cardoso et al., 2022; Macana et al., 2023; Martins et al., 2026). Genetic improvement also plays a fundamental role in identifying materials with greater tolerance to water stress and superior productive performance, contributing to the sustainability of forest systems (Nunes et al., 2016; Henriques et al., 2017; Oliveira et al., 2020; Loiola et al., 2025).

In addition to advances in forest management and genetics, recent studies have expanded the understanding of ecophysiological processes, carbon

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dynamics, and the sustainability of Eucalyptus cultivation across different environments (Maquère et al., 2009; Santos et al., 2023; Moraes et al., 2024; Segtowich et al., 2025). However, despite the significant growth in research in this field, scientific knowledge related to Eucalyptus cultivation and management remains dispersed across different disciplinary approaches, making it difficult to achieve an integrated understanding of the evolution of scientific production and the main research trends.

In this context, bibliometric studies have been widely used to map the evolution of scientific knowledge, identify collaboration networks, the most influential journals, and research gaps in specific fields of study (Scopus, 2026).

1.1 Objetivos Gerais

This study aimed to analyze the scientific landscape of academic production related to the cultivation and management of the genus Eucalyptus from 1986 to 2026, through a bibliometric analysis of publications indexed in the Scopus database.

2. Methodology

The present study is characterized as a bibliometric review with a quantitative, descriptive, and exploratory approach, aiming to map and analyze the scientific production related to the cultivation and silviculture of the genus Eucalyptus, with a focus on studies conducted in Brazil, particularly in the Cerrado biome and the state of Tocantins. The methodological process followed the PRISMA guidelines (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*), ensuring rigor, transparency, and reproducibility in the selection of studies.

Data collection was performed using the Scopus database, covering the period from 1986 to 2026, through the TITLE-ABS-KEY search field, which considers the occurrence of terms in the title, abstract, or keywords of the documents, as shown in Table 1.

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Table 1 – Criteria for searching publications using Scopus.

Criterias	Scopus Collection
Keywords	(("*Eucalyptus*") AND ("Forest Genetic Improvement") AND ("*Eucalyptus* Genetic Improvement") AND ("drought tolerance")).
Subject area and index	Title, Abstract, Keywords
Document Types	Article; Review Article; Conference Paper; Editorial; Book Chapter
Author	Documents written anonymously and undefined document types were excluded.
Years	From 1986 to 2026 (40 years)
Search date	March 14, 2026, at 4:00 PM
Location	Federal University of Tocantins, Gurupi Campus

Source: The authors (2026)

Initially, a broad search was conducted using the descriptors: Eucalyptus OR "Eucalyptus plantation*" OR "Eucalyptus cultivation" OR "Eucalyptus silviculture," resulting in a total of 37,767 records.

The search was refined by including terms related to silviculture and the geographic scope of the study, using the following strategy: *Eucalyptus* OR "Eucalyptus plantation*" OR "Eucalyptus cultivation" OR "Eucalyptus silviculture" AND "forest plantation*" OR silviculture OR forestry AND Tocantins OR "Brazilian Cerrado" OR Cerrado OR Brazil. With this refinement, a total of 1.006 documents were retrieved.

Figure 1. Keyword cloud representation



Source: The authors (2026)

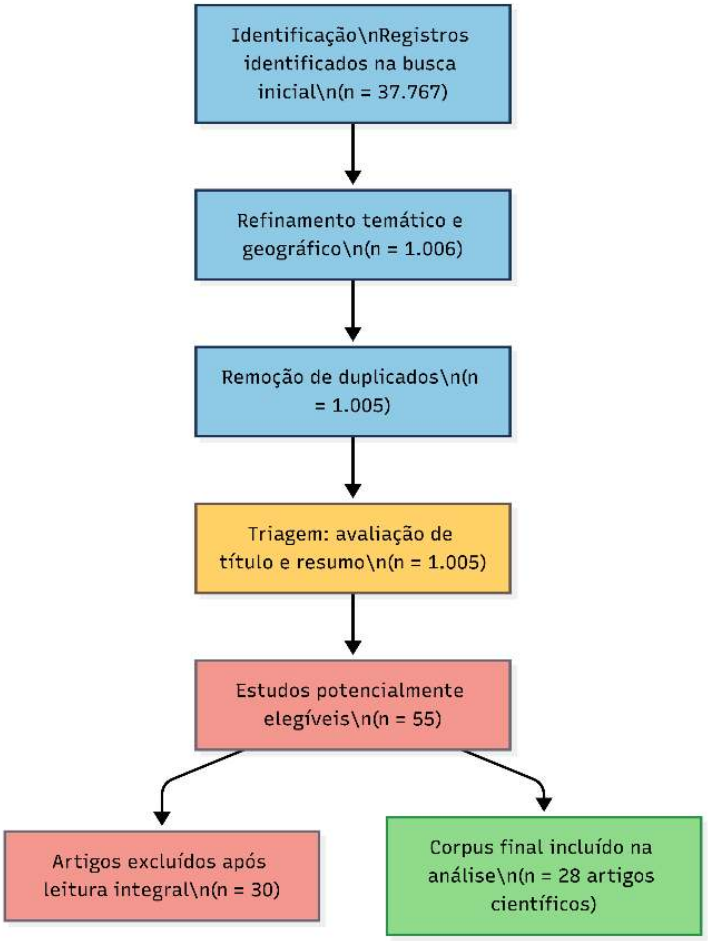
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The metadata were exported in .csv format and organized into databases for analysis. Using RStudio, duplicate records were identified and removed, resulting in a total of 1,005 unique articles. Subsequently, a screening was conducted through the reading of titles and abstracts, applying inclusion criteria related to the cultivation, management, and silviculture of Eucalyptus in the Brazilian context. At this stage, 950 articles were excluded, leaving 55 studies for eligibility assessment.

In the next stage, the 55 articles were subjected to full-text reading, and 30 studies were excluded for not being directly aligned with the scope of the research, as shown in Figure 2.

Figure 2. Flowchart of the study selection process



Source: The authors (2026)

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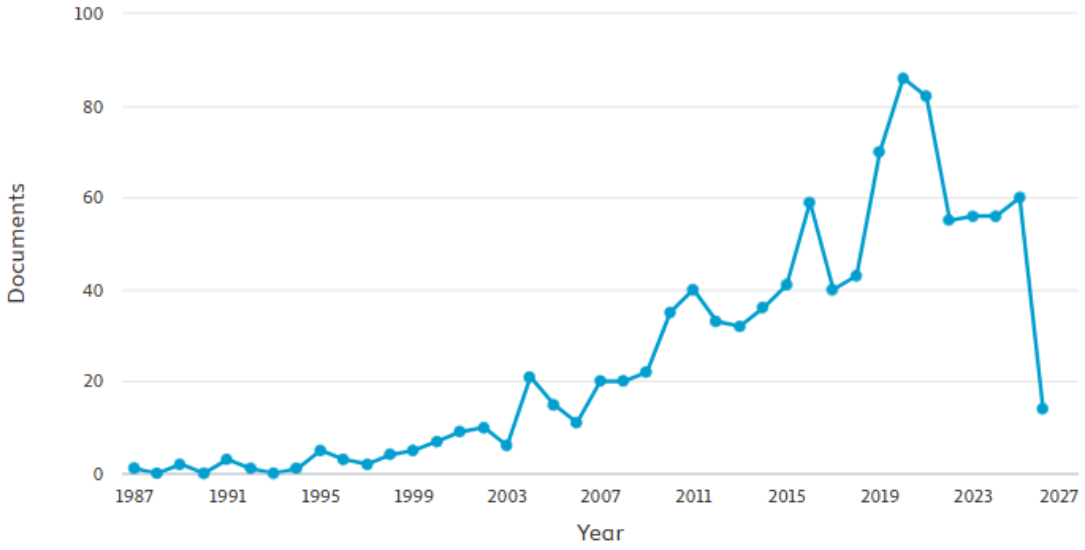
At the end of the selection process, the final corpus consisted of 28 scientific articles, which formed the basis for the bibliometric analysis, allowing the examination of publication trends, main journals, authors, institutions, and research topics related to Eucalyptus cultivation in the Brazilian Cerrado context.

3. Literature Review

3.1 Temporal Evolution of Scientific Production

The assessment of the temporal evolution of scientific production reveals a gradual and consistent increase in publications over the 40-year period analyzed, from 1986 to 2026 (Figure 3).

Figure 3. Temporal evolution of the number of scientific publications



Source: Scopus/Elsevier – Analyze Search Results (2026).

It is observed that between the late 1986s and the mid-1990s, scientific production was quite limited, with few annual records, characterizing an initial stage in the development of the research field. During this period, studies were sporadic and did not yet reflect a consolidated interest of the scientific community in the investigated topic.

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From the late 1990s and early 2000s onward, a progressive increase in the number of publications can be observed, indicating a gradual expansion of scientific interest. Between approximately 2003 and 2010, a more pronounced growth in the number of documents published annually is evident, with values exceeding 20 publications in some years. This increase may be associated with advances in research related to intensive silviculture, genetic improvement, and sustainable forest management, as well as the strengthening of international research networks focused on productivity and sustainability of forest systems (Oliveira et al., 2025; Sanhueza-Novoa et al., 2026).

Between 2010 and 2016, a phase of more pronounced expansion in scientific production is observed, with a continuous increase in the number of documents published annually. During this period, the volume of publications approaches or exceeds 40 documents per year, reflecting the consolidation of the topic within the global scientific agenda. This increase may be associated with the intensification of studies on ecophysiology, efficient water use, fertilization, and productivity in Eucalyptus plantations, topics considered strategic for the advancement of modern silviculture (Binkley et al., 2017; Hubbard et al., 2020).

The most pronounced growth occurred from approximately 2017 onward, when a significant increase in annual scientific production is observed, culminating in the peak of the historical series between 2019 and 2021, during which the number of publications exceeded 80 documents per year (Figure 2). This rise coincides with the expansion of scientific interest in topics related to the adaptation of forest plantations to climate change, water deficit, and productivity optimization under different environmental conditions (Elli et al., 2019; Christina et al., 2023; Hakamada et al., 2023).

In the most recent years, a slight reduction in the number of publications is observed, followed by relative stability. However, this apparent decline in the last year of the series should be interpreted with caution, as it may be associated with incomplete indexing in scientific databases, since recently published articles may not yet have been fully indexed at the time of bibliometric data collection (Donthu et al., 2021).

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Overall, the observed temporal pattern highlights the consolidation and expansion of the research field, demonstrating that studies related to productivity, management, ecophysiology, and adaptation of Eucalyptus plantations have gained increasing scientific relevance over recent decades. This trend follows the growing economic, environmental, and energy importance of Eucalyptus plantations within the context of the bioeconomy and sustainable biomass production (Colodette et al., 2014; André et al., 2021).

3.2 Most influential scientific journals

The distribution of publications by scientific journal allows the identification of the main outlets for disseminating knowledge related to the cultivation, management, and genetic improvement of Eucalyptus. Overall, scientific production is concentrated in journals specialized in agricultural and forest sciences, particularly Forest Ecology and Management, Scientia Forestalis, New Forests, Forests, and Cerne, which show recurrent participation throughout the analyzed historical series.

The scientific journals responsible for publishing the studies included in the corpus allow the identification of the main channels for disseminating knowledge related to the cultivation, management, and genetic improvement of Eucalyptus. Scientific production is primarily concentrated in journals specialized in forest sciences and ecosystem management, particularly Forest Ecology and Management, Scientia Forestalis, Forests, New Forests, Cerne, and Southern Forests.

In the early years of the time series, between 1986 and the early 2000s, scientific production was limited and concentrated in a few journals, with Scientia Forestalis standing out (Figure 3). This pattern reflects the initial stage of consolidation of research on Eucalyptus silviculture, a period in which studies were still relatively sparse and concentrated in traditional forestry research institutions (Sanhueza-Novoa et al., 2026).

From the 2000s onward, a gradual expansion in the number of journals publishing studies on this topic can be observed, reflecting the growing global

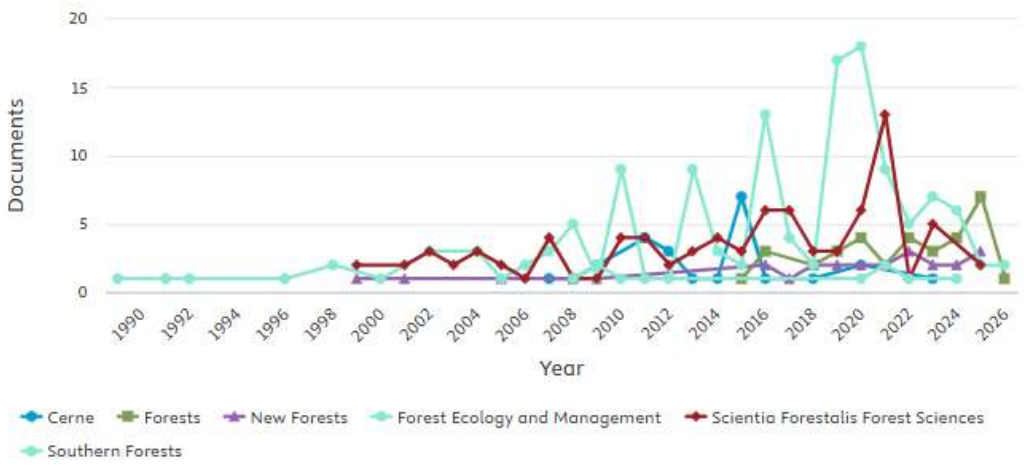
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scientific interest in the productivity and sustainability of forest plantations. This increase coincides with the expansion of genetic improvement programs and advances in research on ecophysiology and silvicultural management of species of the genus Eucalyptus (Binkley et al., 2017; Oliveira et al., 2025).

In this context, the journal Forest Ecology and Management stands out, presenting the highest volume of publications throughout the historical series and recording the most significant peaks in scientific production, especially between 2016 and 2021 (Figure 3). This journal is widely recognized as one of the leading international outlets in applied forest ecology and plantation management, publishing studies related to forest productivity, water use, fertilization, and plantation responses to climate change (Elli et al., 2019; Christina et al., 2023; Hakamada et al., 2023), as shown in Figure 3.

Figure 3. Temporal evolution of the number of scientific publications by journal



Sourch: Scopus/Elsevier – Analyze Search Results (2026).

Figure 3 also shows that the journal Scientia Forestalis has a relevant presence throughout the analyzed period, with a higher frequency of publications from the 2000s onward. As a well-established journal in forest science in Brazil, it has played an important role in disseminating research on genetic improvement,

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ecophysiology, and the management of Eucalyptus plantations (Henriques et al., 2017; Nunes et al., 2016).

Other journals have also shown increasing participation over the last two decades. The journal Forests, for example, presents a more pronounced increase in publications in recent years, reflecting the expansion of research on nutrient management, sustainability of forest production systems, and the adaptation of plantations to environmental changes (Martins et al., 2026). Similarly, New Forests has contributed with studies related to productivity, fertilization, and root growth in forest plantations under water deficit conditions (Macana et al., 2023).

The journals Cerne and Southern Forests show a more moderate but consistent participation throughout the analyzed period. These journals play a relevant role in disseminating regional studies and research conducted in tropical environments, contributing to the publication of experimental results and applied analyses in forest management.

Overall, the results indicate that scientific production on Eucalyptus cultivation is strongly concentrated in journals specialized in forest sciences. The predominance of high-impact international journals, particularly Forest Ecology and Management, highlights the global relevance of research related to productivity, ecophysiology, and climate adaptation of Eucalyptus plantations, reinforcing the consolidation of this topic as a strategic area within modern silviculture.

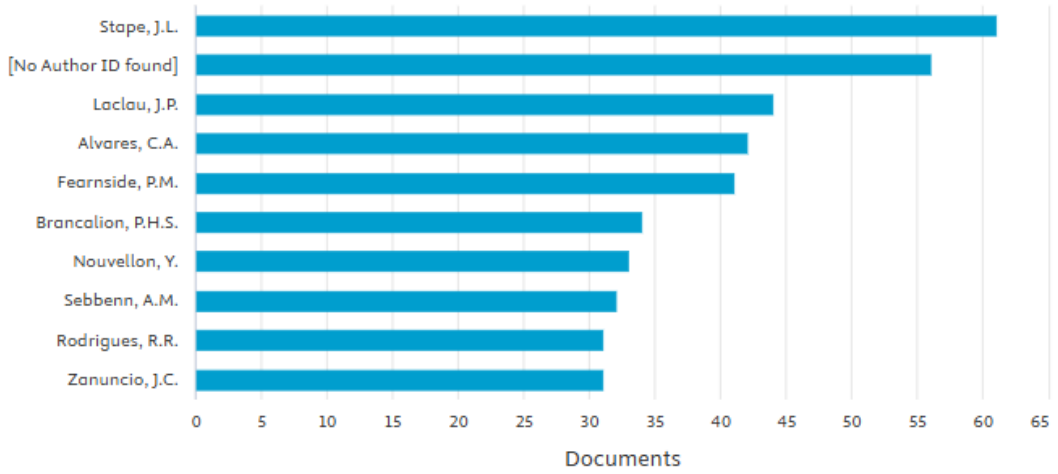
3.3 Most productive authors and scientific consolidation

The distribution of the number of publications per author reveals the existence of a consolidated core of researchers responsible for driving the advancement of knowledge in Eucalyptus silviculture, particularly in the context of forest plantation ecology, as shown in Figure 4.

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Figure 4. Most productive authors in scientific production



Sourch: Scopus/Elsevier – Analyze Search Results (2026).

Figure 4 shows that José Luiz Stape (Stape, J. L.) leads scientific production, with approximately 60 to 65 publications, standing out as one of the leading global researchers in the field, particularly in studies on potential productivity, interactions among climatic factors, nutrition, and management of Eucalyptus plantations (Stape et al., 2010; Binkley et al., 2017). Following this, a considerable number of records without author identification is observed, totaling around 55 documents, indicating possible indexing inconsistencies in the Scopus database.

Among the identified authors, Jean-Paul Laclau (Laclau, J. P.) stands out, with approximately 45 publications, whose work is strongly associated with nutrient cycling, carbon dynamics, and the ecophysiological functioning of intensive forest plantations (Gonçalves et al., 2008; Maquère et al., 2009). Following this, Carlos Alberto Alvares (Alvares, C. A.) and Philip M. Fearnside (Fearnside, P. M.) present around 40 and 42 documents, respectively, with relevant contributions in the areas of applied climatology, environmental change, and the sustainability of forest systems.

Other prominent authors include Paulo Henrique da Silva Brancalion (Brancalion, P. H. S.), Yann Nouvellon (Nouvellon, Y.), Alexandre M. Sebbenn (Sebbenn, A. M.), Rodrigo R. Rodrigues (Rodrigues, R. R.), and João Carlos

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Zanuncio (Zanuncio, J. C.), each with publication outputs ranging from 30 to 35 documents. These researchers work across different areas of forest science, including genetic improvement, ecological restoration, ecophysiology, and forest protection, contributing to an integrated understanding of *Eucalyptus*-based production systems (Oliveira et al., 2020; Nunes et al., 2016; Segtowich et al., 2025).

Overall, the results indicate that scientific production on Eucalyptus is strongly concentrated within a relatively small group of highly productive authors, who play a central role in structuring the research field. This concentration is characteristic of mature areas of knowledge, where scientific leadership is associated with high productivity and active participation in international collaboration networks (Donthu et al., 2021; Moral-Muñoz et al., 2020). Thus, the identification of these authors reinforces the existence of a consolidated scientific core responsible for driving theoretical advances and technological applications aimed at the sustainability and intensification of forest production under changing environmental conditions.

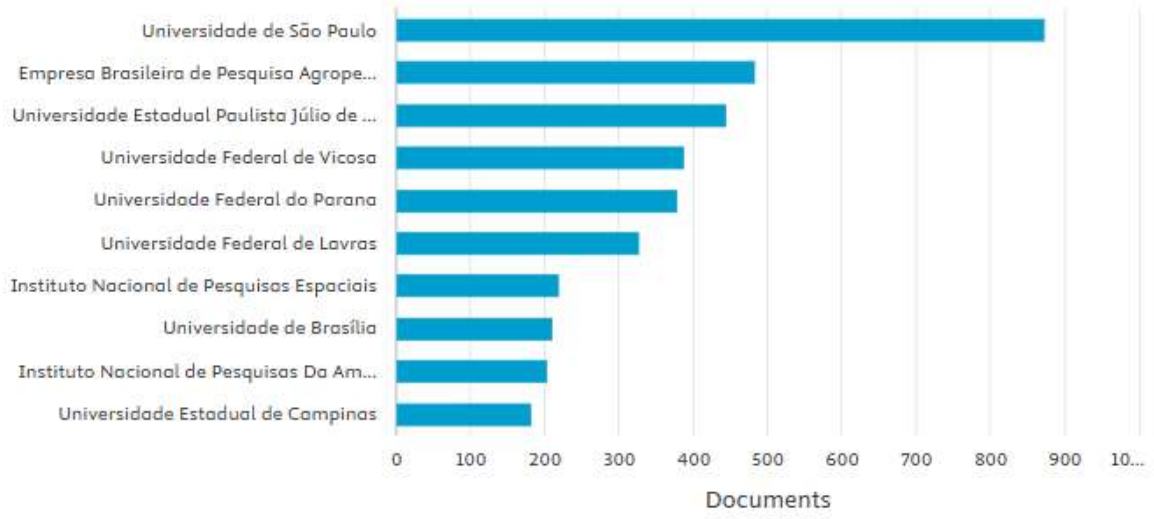
3.4 Most productive institutions

The analysis of the most productive institutions reveals a strong concentration of scientific production in Brazilian universities and research centers specialized in agricultural and forest sciences, as shown in Figure 5.

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Figure 5. Most productive institutions in scientific production



Sourch: Scopus/Elsevier – Analyze Search Results (2026).

The University of São Paulo (USP) stands out prominently, with the highest volume of publications (approximately 850–900 documents), consolidating its position as the leading research hub on Eucalyptus in Brazil, particularly in studies related to productivity, ecophysiology, and forest plantation management (Binkley et al., 2017). Following this, the Brazilian Agricultural Research Corporation (EMBRAPA) is also noteworthy, with around 500 documents, highlighting its strategic role in applied research involving soil fertility, nutrient management, and the sustainability of production systems (Cardoso et al., 2022; Martins et al., 2026).

Among other prominent institutions are São Paulo State University (UNESP) and the Federal University of Viçosa (UFV), both with high scientific output (approximately 400–450 documents), recognized for their contributions in genetic improvement, forest physiology, and species adaptation to the Cerrado (Henriques et al., 2017; Oliveira et al., 2020). Additionally, institutions such as the Federal University of Paraná (UFPR) and the Federal University of Lavras (UFLA), with approximately 300 and 350 documents, reinforce Brazil's academic leadership, particularly in research focused on silvicultural management and forest growth dynamics (Fernandez et al., 2000; Elli et al., 2019).

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Among the prominent institutions are São Paulo State University (UNESP) and the Federal University of Viçosa (UFV), both with high scientific output (approximately 400 and 450 documents), recognized for their contributions in genetic improvement, forest physiology, and species adaptation to the Cerrado (Henriques et al., 2017; Oliveira et al., 2020).Additionally, institutions such as the Federal University of Paraná (UFPR) and the Federal University of Lavras (UFLA), with approximately 300 and 350 documents, reinforce Brazil's academic leadership, particularly in research focused on silvicultural management and forest growth dynamics (Fernandez et al., 2000; Elli et al., 2019).

In addition, institutions such as the National Institute for Space Research (INPE), the University of Brasília (UnB), the National Institute of Amazonian Research (INPA), and the University of Campinas (UNICAMP) are also represented, with production ranging from 180 to 250 documents. This reflects the incorporation of interdisciplinary approaches, including remote sensing, environmental modeling, and climate change. This institutional set not only highlights Brazil's leadership in scientific production on *Eucalyptus*, but also demonstrates strong collaboration among universities, research centers, and public institutions, a hallmark of consolidated scientific systems. Overall, the results reinforce that advances in this field are grounded in robust institutional networks with a high capacity for generating and disseminating technologies aimed at the sustainable intensification of silviculture (Colegario et al., 2005; Hubbard et al., 2010; Christina et al., 2023; Rodrigues et al., 2021).

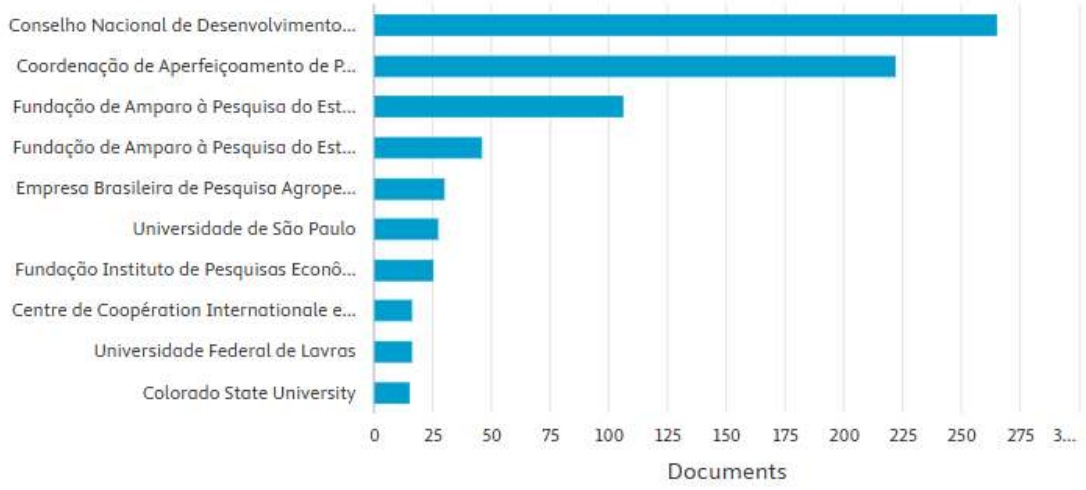
3.5 Research funding agencies

The analysis of the most productive institutions reveals a strong concentration of scientific production in Brazilian universities and research centers specialized in forest sciences (Figure 6). Among the institutions with the highest number of publications, the University of São Paulo (USP) stands out, presenting the largest volume of documents and consolidating its position as one of the main research hubs in silviculture and Eucalyptus plantation management in Brazil.

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Figure 6. Main funding agencies of scientific production



Sourch: Scopus/Elsevier – Analyze Search Results (2026).

Regarding funding agencies, a strong leading role of public research funding institutions in the scientific development related to Eucalyptus cultivation and management is evident (Figure 6). The National Council for Scientific and Technological Development (CNPq) presents the highest number of associated documents, followed by the Coordination for the Improvement of Higher Education Personnel (CAPES), indicating that scientific production in this field is largely supported by public policies aimed at research funding and human resource development in Brazil.

In addition to these federal agencies, State Research Support Foundations (FAPs), particularly FAPESP, also stand out, contributing significantly to the funding of scientific projects related to silviculture, ecophysiology, and forest plantation management. The support of these institutions has been essential for the development of research on productivity, nutrient management, and the adaptation of Eucalyptus plantations to tropical environmental conditions (Fernandez et al., 2000; Stape et al., 2010; Sanhueza-Novoa et al., 2026).

The presence of research institutions such as the Brazilian Agricultural Research Corporation (EMBRAPA), as well as universities and international centers such as CIRAD and Colorado State University, highlights the existence of

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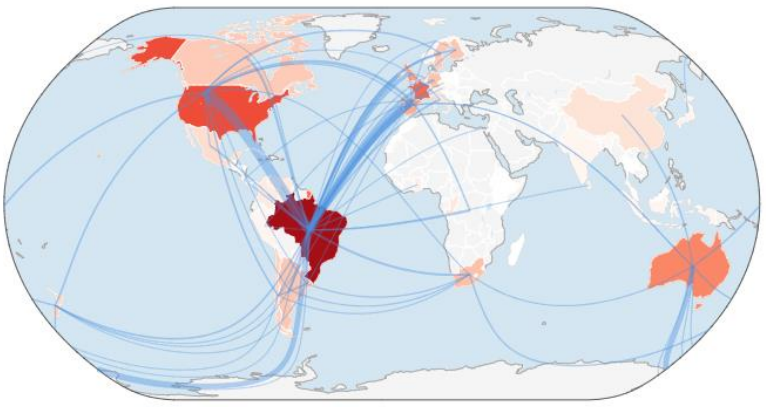
national and international collaborative networks aimed at generating scientific knowledge and technological innovation in the forestry sector. These partnerships have contributed to advances in strategic areas such as ecophysiology, forest genetics, and the productive sustainability of *Eucalyptus* plantations (Binkley et al., 2017; Hubbard et al., 2020; Christina et al., 2023).

Overall, the results demonstrate that scientific production on Eucalyptus cultivation is strongly supported by public funding systems and international research networks, which have enabled significant advances in understanding the factors influencing forest development, efficient water use, and the adaptation of plantations to climate change (Elli et al., 2019; Hakamada et al., 2023; Martins et al., 2026).

3.6 Geographic distribution of scientific production

The geographic distribution of publications, combined with the international collaboration network shown in Figure 7, reveals a strong centralization of scientific production in Brazil, which stands out markedly compared to other countries.

Figure 7. Geographic distribution of scientific production by country



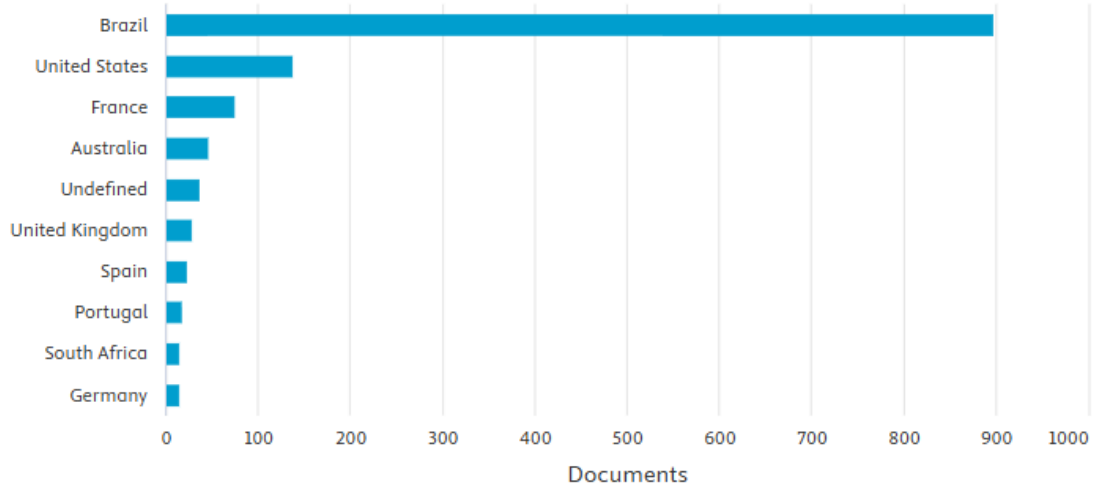
According to the documents-by-country graph, Brazil accounts for approximately 900 publications, a value significantly higher than that of the second-ranked country, the United States (around 120–150 documents), followed by France and Australia, with more moderate participation. This pattern is

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corroborated by the collaboration map, in which Brazil appears as the main scientific hub, concentrating connections with several countries in North America, Europe, Africa, and Oceania (Figure 8).

Figure 8. Geographic distribution of scientific production by country



Sourch: Scopus/Elsevier – Analyze Search Results (2026).

This Brazilian leadership directly reflects its strategic position in the global forestry sector, as the country has extensive areas planted with Eucalyptus and a high technological level in the production of wood, biomass, and pulp (Colodette et al., 2014; Stape et al., 2010; Martins et al., 2026). In addition, the strong connectivity observed in the map indicates that Brazil acts as a central hub in international scientific networks, promoting collaboration with countries such as the United States, France, and Australia.

The United States ranks second in publication volume and shows strong interaction with Brazil, particularly in studies on ecophysiology, water balance, and forest productivity (Hubbard et al., 2010; Hubbard et al., 2020; Binkley et al., 2017). France, in turn, stands out through the involvement of institutions such as CIRAD, which are frequently engaged in collaborative research with Brazilian groups focused on nutrient cycling and carbon dynamics in tropical systems

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(Maquère et al., 2009; Stape et al., 2010). Australia also contributes significantly in areas such as forest genetics, ecophysiology, and species adaptation, given its importance as the center of origin of the genus Eucalyptus (Nunes et al., 2016; Oliveira et al., 2020).

Other countries, such as the United Kingdom, Spain, Portugal, Germany, and South Africa, show more modest participation in terms of publication volume, but maintain a relevant presence in international collaboration networks, contributing mainly to studies on climate change, sustainability, and modeling of forest systems (Elli et al., 2019; Christina et al., 2023; Segtowich et al., 2025).

Overall, the results show that scientific production on *Eucalyptus* is strongly led by Brazil, not only in terms of volume but also in its centrality within global research networks. This configuration reinforces the country's position as a global reference in plantation silviculture, while also demonstrating the increasing internationalization of the scientific field, characterized by intense flows of collaboration and knowledge exchange (Donthu et al., 2021; Hakamada et al., 2023).

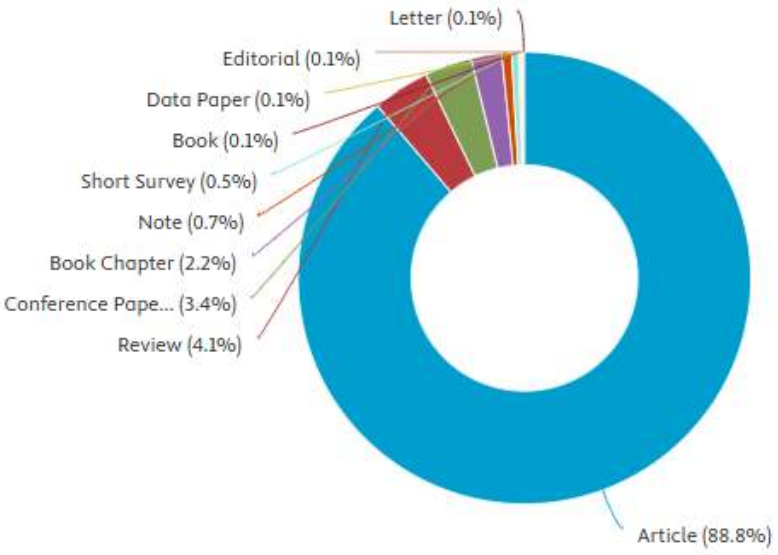
3.7 Types of scientific documents

The typology of documents shows a clear predominance of articles, which account for approximately 88.8% of the identified publications (Figure 8). This result indicates that scientific production related to *Eucalyptus* cultivation is strongly concentrated in original studies published in scientific journals, reflecting the experimental and applied nature of research in silviculture and forest plantation management, as shown in Figure 9.

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Figure 9. Typological distribution of scientific documents related to Eucalyptus cultivation and management.



Sourch: Scopus/Elsevier – Analyze Search Results (2026).

To a lesser extent, review articles (4.1%) are also observed, which play an important role in synthesizing scientific knowledge and consolidating methodological and conceptual advances in the field of forest research. These studies contribute to integrating different approaches related to productivity, ecophysiology, genetic improvement, and the sustainability of *Eucalyptus* plantations (Stape et al., 2010; Sanhueza-Novoa et al., 2026).

Other types of documents also appear in the analyzed database, although with relatively lower participation, such as conference papers (3.4%), book chapters (2.2%), technical notes (0.7%), and short surveys (0.5%). These categories generally correspond to preliminary communications of scientific results or theoretical discussions related to the advancement of knowledge in the field.

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Residual categories, such as books, data papers, editorials, and letters, each account for approximately 0.1% of the publications. Although less frequent, these document types contribute to the dissemination of data, conceptual discussions, and brief communications on scientific advances in the field of forest sciences.

Overall, the predominance of articles demonstrates the strong orientation of the field toward the generation of empirical knowledge, based on field experimentation, growth modeling, ecophysiological studies, and forest productivity analyses. This pattern is consistent with the applied nature of research on Eucalyptus, which frequently investigates factors such as nutrient management, interactions between climate and productivity, water-use efficiency, and the genetic selection of materials better adapted to environmental conditions (Fernandez et al., 2000; Binkley et al., 2017; Elli et al., 2019; Hakamada et al., 2023; Martins et al., 2026).

Thus, the typological distribution of documents confirms the consolidation of the scientific field, characterized by the predominance of original studies and the continuous production of empirical evidence aimed at improving the productivity and sustainability of *Eucalyptus* under different environmental contexts (Colodette et al., 2014; Christina et al., 2023; Segtowich et al., 2025).

4. Final Considerations

It can be concluded that scientific production on the cultivation and management of *Eucalyptus*, as indexed in the Scopus database, has evolved over recent decades, consolidating and expanding the field at the international level. The progressive growth in publications from 1986 to 2026 intensified from the 2010s onward, reflecting the increasing scientific interest in forest productivity, ecophysiology, nutrient management, and adaptation to climate change.

Publications were concentrated in journals specialized in agricultural and forest sciences, such as Forest Ecology and Management, as well as among highly productive researchers and leading institutions in the forestry field, particularly Brazilian universities and international research centers

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Finally, the results demonstrated that Brazil holds a leading position in scientific production related to Eucalyptus cultivation, driven by the economic and strategic importance of forest plantations in the country and the strong involvement of universities, research centers, and funding agencies. The predominance of scientific articles reinforces the experimental and applied nature of research, focused on improving productivity and sustainability of forest systems. The study showed that Eucalyptus silviculture is a consolidated and expanding scientific field, highlighting the importance of continuing research, especially in light of challenges related to climate change, sustainable production, and the intensification of forest management in tropical environments.

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