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Technical Paper

Estimation and Analysis of Bamboo Resources and Species Distribution in Brazil

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The International Bamboo and Rattan Organization, INBAR, is an intergovernmental organization dedicated to the promotion of bamboo and rattan for sustainable development. For more information, please visit www.inbar.int.

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Executive summary

This study, *Estimation and Analysis of Bamboo Resources and Species Distribution in Brazil*, commissioned by the International Bamboo and Rattan Organization (INBAR) and conducted with BAMbuild (supported by Fundação de Amparo à Pesquisa do Estado de São Paulo FAPESP, PIPE project number: 2022/01191-3 and 2022/08553-8), and NAP BioSMat - University of São Paulo (USP), provides a detailed account of Brazil's bamboo resources. As an intergovernmental development organization, INBAR seeks to promote poverty reduction and environmental protection through the sustainable utilization of bamboo and rattan resources. Brazil, an INBAR member since 2017, possesses rich bamboo diversity and has enacted supportive legislation for bamboo's sustainable management and integration into various sectors. The report aimed to collect secondary data about bamboo species diversity and distribution throughout the country regions and states.

It addresses the multifaceted landscape of bamboo resources in Brazil, encompassing an extensive literature review, database analysis, and insightful results. Through an amalgamation of secondary data, expert consultations, the study has estimated the bamboo coverage across Brazilian states, revealing considerable regional variations. To validate and confirm the data collected from these methods, technical site visits were employed selectively in certain states alongside image analysis using Remote Sensing (RS). RS was pivotal in confirming the presence of bamboo where it was previously reported, though it did not enable precise measurements of extent or density because of the challenges posed by dense forest canopies and the similar spectral signatures of bamboo and other vegetation, which complicate the differentiation and accurate quantification of bamboo stands.

A notable finding is the substantial bamboo coverage in Acre, estimated at 4,563,600 hectares, based on advanced remote sensing techniques from previous research. This significant figure suggests the potential underestimation of bamboo resources in other regions where data were primarily gathered through questionnaires, consultations, or less detailed reports. The states of Amazonas and Mato Grosso do Sul also show significant bamboo presence, while others like Espírito Santo and Rio de Janeiro report minimal areas, and there was lack of data for Amapá,

Pará, Rondônia, Roraima, and Tocantins states. This disparity underscores the necessity for improved data collection methods to accurately capture the distribution of bamboo.

The study estimates Brazil's bamboo coverage at approximately 5.26 million hectares, a conservative figure considering the limitations in detecting bamboo beneath dense canopies and complex terrain. This suggests that the actual extent of bamboo resources in Brazil could be considerably higher. The report recommends enhanced remote sensing, more on-ground interviews, and improved image analysis techniques to provide a more comprehensive inventory. The REFLORA platform, managed by the Instituto de Pesquisa Jardim Botânico Rio de Janeiro, served as a crucial source for up-to-date and comprehensive data on bamboo species in Brazil. The results reveal a rich tapestry of bamboo diversity, with Brazil hosting a total of 316 species within the Bambusoideae Luerss. subfamily, distributed across 52 genera. The Northeast region emerged as the most diverse, showcasing 73.5% of the identified genera. The Atlantic Rainforest, Southeast, and Amazonia phytogeographic regions demonstrated significant bamboo diversity, with the Atlantic Forest standing out as the most diverse biome. This study highlights the pivotal role of platforms like REFLORA in advancing our understanding of bamboo resources in Brazil.

In conclusion, the *Estimation and Analysis of Bamboo Resources and Species Distribution in Brazil* serves as a foundational analysis of the bamboo sector in Brazil, indicating significant potential for industrial development and biodiversity conservation. The study lays the groundwork for strategic initiatives, emphasizing the need for advanced methodologies to accurately determine the full scale and potential of Brazil's bamboo resources. The results are a steppingstone towards a more sustainable and economically viable bamboo industry in Brazil, in line with INBAR's mission for sustainable development and environmental stewardship.

1. Introduction

Bamboo, renowned for its versatility, stands as a botanical marvel with extensive applications in agriculture, manufacturing, construction, and environmental initiatives (Brand et al., 2019; Kadivar et al., 2020; Kumar et al., 2023). Its pivotal role in ecological and economic systems is underscored by rapid growth, adaptability, and resilience, positioning it favorably among forestry species (Getahun et al., 2023; Scurlock et al., 2000). It plays a crucial part in rural societies, erosion control (Shinohara et al., 2019), biodiversity conservation, riverbank protection, carbon sequestration, and overall forest health (Ananfack et al., 2023; Isukuru et al., 2023). This unique combination of traits endows bamboo with the ability to mature early and be harvested multiple times within a short span, distinguishing it as a valuable natural resource.

Beyond its botanical features, bamboo's global significance lies in its versatility as a renewable and cost-effective resource, thriving across diverse climatic and soil conditions (Ahmad et al., 2021; Shinohara et al., 2019). Its reach spans continents, notably in Asia, America, and Africa, with introduced species compensating for its absence in Europe (Ahmad et al., 2021).

While the primary concentration of bamboo species traditionally remains in Asia (Eric, 2023), Latin America stands out with significant bamboo resources, identified in at least ten countries (Scurlock et al., 2000). Although precise assessments are still to be done, a total of over 10 million hectares is considered a realistic estimate for the region. Brazil, Chile, Colombia, Ecuador, and Mexico emerge as key contributors to the bamboo landscape, holding rich bamboo resources (Lobovikov et al., 2007).

Brazil stands out globally in terms of bamboo availability and potential, recognized as one of the world's leaders in bamboo resources (FAO, 2010; Lobovikov et al., 2007). São Paulo, for example, is the sole state where there is extensive cultivation of bamboo culms, primarily of *Phyllostachys edulis*, *Phyllostachys aurea*, and *Dendrocalamus asper* (Greco et al., 2015).

Upon extensive research across various sources, it was apparent that the available bamboo resource area and the number of species present in different geographic areas are changing in recent years, which indicates that the identification of different species and the coverage of new areas are being made.

Greco et al. (2015) reported that Brazil has 256 species of bamboo (subfamily Bambusoideae), being 164 endemic species, within the same amount of woody bamboo genera (FAO, 2020).

To date, comprehensive studies providing updated information on bamboo resources in Brazil, including the number of species and genera, their endemic status, and their distribution across states, remain scarce.

This report addresses existing information gaps in the literature through a multidisciplinary research project aimed at aggregating and synthesizing data related to bamboo resources in Brazil. The project covers diverse aspects, including bamboo species diversity, geographical distribution, growth dynamics, and the prevalence of bamboo plantations. The objectives of this report are to compile a comprehensive data of all bamboo species in Brazil, document their current distribution, and assess the variation in bamboo populations across different regions of the country.

1.1. Morphological Distinctions of Bamboos

Bamboos are a type of plant found within the subfamily *Bambusoideae*, which is one of the 12 subfamilies within the larger grass family known as *Poaceae*. *Bambusoideae* consists of 1642 species, spread across 123 genera, and is categorized into three tribes: *Arundinarieae*, encompassing temperate woody bamboos; *Bambuseae*, which comprises tropical woody bamboos; and *Olyreae*, which includes herbaceous bamboos (Vorontsova et al., 2016).

The distinction between herbaceous and woody bamboos is primarily based on eight characteristics, most of which are morphological in nature. While the information in Table 1 can be useful for discerning between herbaceous and woody bamboos, there are exceptions to some characteristics. For instance, in the genera *Eremitis Döll* and *Olyra L.*, both classified as herbaceous, some plants can grow taller than 3 meters. In *Colanthelia McClure*, *Chusquea Kunth*, and *Aulonemia Goudot*, the culms can be quite slender, and in some cases, they may climb or sprawl. Certain species of *Chusquea* and *Guadua Kunth* can exhibit continuous flowering. Additionally, it's important to note that not all woody species have been tested for their ability to withstand direct sun exposure.

Table 1. Key distinguishing features of herbaceous vs woody bamboos.

Characteristics	Herbaceous	Woody
Height	Usually < 2m high	1-35m high
Branching	Simple	Complex
Culm consistency	Not lignified; easily breakable between 2 fingers	Lignified; not breakable between 2 fingers
Culm leaves	Absent	Present
Outer ligule	Absent	Present
Flowers	Unisexual	Bisexual
Flowering	Continuous (polycarpic)	Seasonal (monocarpic)
Direct sun exposure	Not tolerant	Tolerant

Source: Adapted from (Londoño, 2002).

2. Methodology

To conduct this study, several methodologies were applied to ensure a comprehensive and nuanced exploration of bamboo resources in Brazil.

2.1. Secondary Data Collection

The study collects and consolidates existing data from secondary sources, including governmental reports, scholarly publications, industry documents, and databases. These sources provide the foundational data necessary for the assessment of bamboo resources in Brazil. This comprehensive secondary data compilation serves as the primary basis for subsequent analyses. This data collection includes the bamboo species diversity, geographical distribution, growth dynamics, prevalence of bamboo plantations.

The multidisciplinary Scopus database was then meticulously analyzed, offering a wealth of insights into scientific studies related to bamboo. This comprehensive analysis included identifying patterns in scholarly publications, understanding subject areas, and assessing Brazil's standing in the broader context of bamboo research. Scopus proved instrumental in categorizing studies by subject, revealing the dynamic trends in bamboo-related research over time.

In the past 20 years, scientific studies towards bamboo utilization have increased exponentially, reaching around 2500 documents (See Figure 1), with Brazil being representative on the overall publications. The scientific reports cover a wide range of subject areas, spanning from medicine to engineering, highlighting the versatility of bamboo as a valuable resource. Most documents are published in the field of Agricultural and Biological Sciences, making up 18% of the total, closely followed by Engineering and Materials Science, both representing 14% of the publications (See Figure 1). In the global context, Brazil ranks sixth in terms of the number of scientific documents in the bamboo area with a total number of 938 publications on the Scopus database.

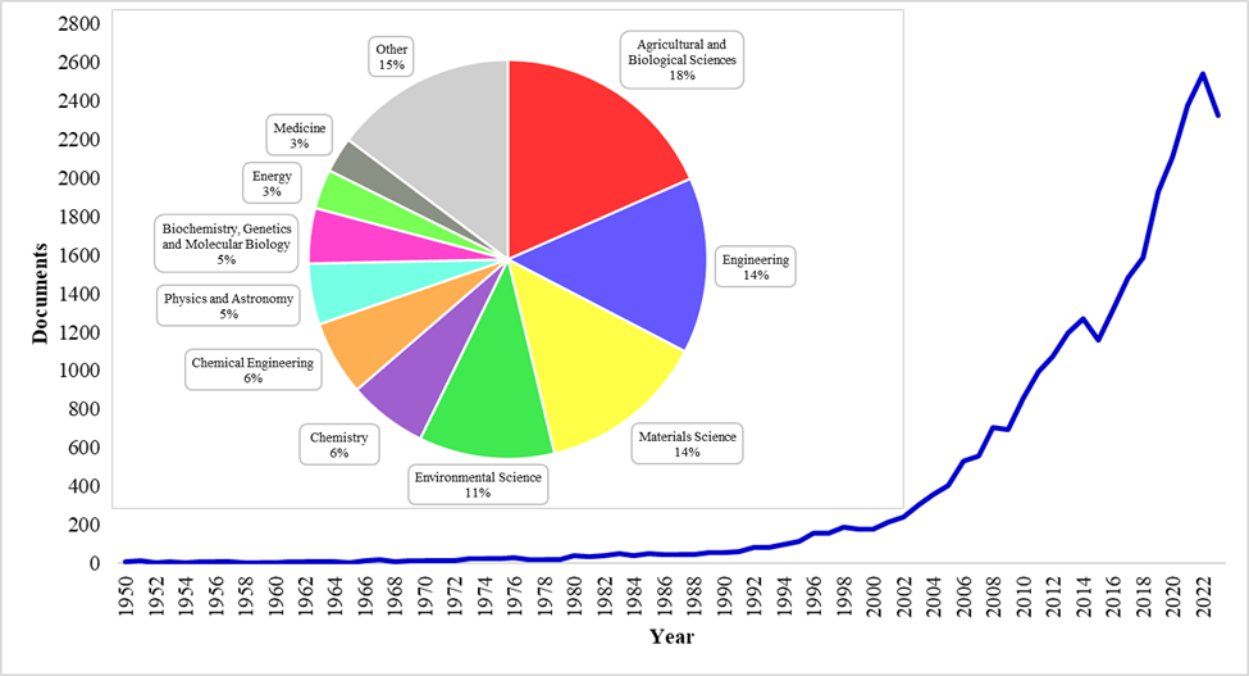


Figure 1. Research documents in bamboo by subject area and year: (1950-2023).
Notes: Data adapted from Scopus database.

2.2. Interview and Expert Consultation

Recognizing the dynamic nature of bamboo ecosystems and the nuanced knowledge required for accurate assessment, the study involves expert consultation. Experienced researchers, botanists, and practitioners with extensive expertise in bamboo cultivation and management are consulted to provide insights and validate the data.

2.3. Questionnaires

To complement the expert insights, questionnaires were designed and distributed to a wide range of stakeholders directly involved in the bamboo value chain, including small-scale farmers, large plantation owners, and bamboo product manufacturers. The questionnaires were structured to elicit detailed information on bamboo farming practices, the scale of operations, market dynamics, and the challenges faced by cultivators. This direct engagement with stakeholders provided a rich source of empirical data, offering a ground-level view of the bamboo sector that enhanced the comprehensiveness of our study.

2.4. Data Retrieval through REFLORA Platform

The REFLORA platform, administered by the Instituto de Pesquisa Jardim Botânico Rio de Janeiro, played a pivotal role in sourcing comprehensive data on bamboo species in Brazil. As a component of the broader initiative, "Flora e Funga do Brasil," REFLORA is integral to fulfilling Target 1 established by the Global Strategy for Plant Conservation within the Convention on Biological Diversity. With the collaborative efforts of over 900 taxonomists, both Brazilian and international, this online platform focuses on morphological descriptions, identification keys, illustrations, and nomenclature for all plant, algae, and fungi species in Brazil. The platform's significance lies in providing a wealth of taxonomic information, including accepted names, synonyms, geographic distribution, life forms, substrate details, and vegetation types for the species. Its extensive database encompasses a rich repository of high-resolution images of exsiccates, species in their natural habitats, and scientific illustrations. Notably, the Flora e Funga do Brasil project recognizes a staggering 52,236 species, encompassing Algae, Bryophytes, Ferns, Lycophytes, Gymnosperms, Angiosperms, and Fungi. The ongoing commitment to inclusivity and engagement with taxonomic communities underscores the platform's continuous efforts to refine and expand its taxonomy, reflecting the dynamic nature of biodiversity in Brazil.

2.5. Remote Sensing, Image Analysis, and Collaborative Mapping

Remote sensing and image analysis were integral to assessing Brazil's bamboo resources from afar, leveraging Google Maps imagery and aerial photographs to gauge bamboo distribution and density. This technique, while challenging in achieving precise measurements, was crucial in supplementing and verifying data gathered through other methods. In addition, the study capitalized on the collaborative mapping initiative hosted by "https://www.bambuzeirosdobrasil.com.br/", a platform developed by Mr. Bruno Imbroisi. This website serves as a repository for bamboo enthusiasts and professionals to share their locations, bamboo plantations, and projects, facilitating a community-driven approach to mapping bamboo resources. Users contribute data directly to Imbroisi, who then updates the map, making it an invaluable tool for identifying potential contacts and visualizing bamboo cultivation areas. The integration of this collaborative mapping with remote sensing and image analysis enriched our dataset, providing a more nuanced understanding of bamboo's presence across various landscapes and aiding in the identification of key stakeholders within the bamboo sector.

2.6. ArcMap software

To enhance spatial understanding and visualization of the collected data, the utilizes ArcMap software. This software is used to create concentration and distribution maps of bamboo species in Brazil. These maps offer a clear depiction of the geographic regions where specific bamboo species are prevalent, aiding in the assessment of bamboo resource distribution and its relevance to different regions.

3. Results & Discussion

3.1 Global Ranking in Bamboo Area According to the Literature

According to the most recent publication on bamboo area, (FAO, 2020), Brazil holds the distinction of having the largest expanse of bamboo in the Americas and is ranked third globally, covering 5,372,400 hectares. The studies and national reports show that the largest natural bamboo forest covers approximately 180,000 square kilometers across Brazil, Peru, and Bolivia, and is known as “Tabocais” in Brazil and “Pacales” in Peru (Londoño, 2002). In terms of worldwide bamboo cultivation, India claims the top spot with 17,416,000 hectares, followed by China with 6,816,500 hectares (Figure 2 and Table 2). However, the area of bamboo seems to have been overestimated in Brazil. Based on the results of (FAO, 2010), bamboo area has been estimated to be constant at 9,300,000 hectares during a ten-year period from 1990 to 2010, representing the largest area of bamboo in the world, as opposed to the estimation of (FAO, 2020) with 5,502,160 hectares of bamboo area in 2010. On the other hand, (Lobovikov et al., 2007) claim that Approximately 9 million hectares of forest area in the southeastern Amazon region are primarily covered by bamboo.

As noted by (FAO, 2020), area of bamboo in India had risen steadily from 1990 to 2010 and peaked at 5,476,000 ha in 2010. In contrast, according to (FAO, 2010), bamboo area has experienced a significant rise in India since 1990, ranging between 7,042,000 ha and 17,416,000 ha. It is worth mentioning that the bamboo area in Brazil had unexpectedly experienced a downward trend during the years 1990-2020, despite the bamboo area in other two leading nations, India and China, had sloped upward (See Figure 3). This phenomenon could be explained by the estimation bias which had been adjusted over time.

Table 2. Trends in area of bamboo by country and region: 1990–2020.

Country/region	Area of bamboo (1000 ha)				
	1990	**2000**	**2010**	**2015**	**2020**
Cameroon	6	6	6	6	6
Ethiopia				1474.46	1474.46
Kenya	56	73	59	60	60
Senegal	715.74	683.74	655.74	641.74	627.74
Sudan	40	30	31	31	30
United Republic of Tanzania	2450	2450	2450	2450	2450
Total Africa	**3267.74**	**3242.74**	**3201.74**	**4663.2**	**4648.2**
Bangladesh				5.69	
Cambodia	31.46	76.44	130.93	125.4	119.87
China	3855.8	4868.54	6033.54	6451	6816.5
India	7042	10500	13958	15687	17416
Japan	149	153	158	162	164
Lao People's Democratic Republic		66	93	90	90
Republic of Korea	20	21	21	22	24
Viet Nam		788.71	654.9	373.1	240.93
Total Asia	**11,098.26**	**16,473.69**	**21,049.37**	**22,916.19**	**24,871.3**
Total Europe	**0**	**0**	**0**	**0**	**0**
Cuba	4	4.83	4.82	4.87	5
Guadeloupe	0.75	0.75	0.75	0.75	0.75
Jamaica	37.47	44.78	80.82	98.89	116.89
Martinique	1.8	2.09	2.31	2.41	2.51
Mexico			0.03	0.21	
Trinidad and Tobago	0.05	0.05	0.05	0.05	0.05
Total North and Central America	**44.07**	**52.5**	**88.78**	**107.18**	**125.2**
Total Oceania	**0**	**0**	**0**	**0**	**0**
Brazil	5773.51	5676.11	5502.16	5446.41	5372.4
Ecuador				16.14	
Venezuela (Bolivarian Republic of)	0.22	0.22	0.22	0.22	0.5
Total South America	**5773.73**	**5676.33**	**5502.38**	**5462.77**	**5372.9**
World	**20,183.8**	**25,445.26**	**29,842.27**	**33,149.34**	**35,017.6**

Source: Adapted from the FAO FRA (FAO, 2020).
Notes: Nations with unavailable data or insignificant values are not presented in the table.

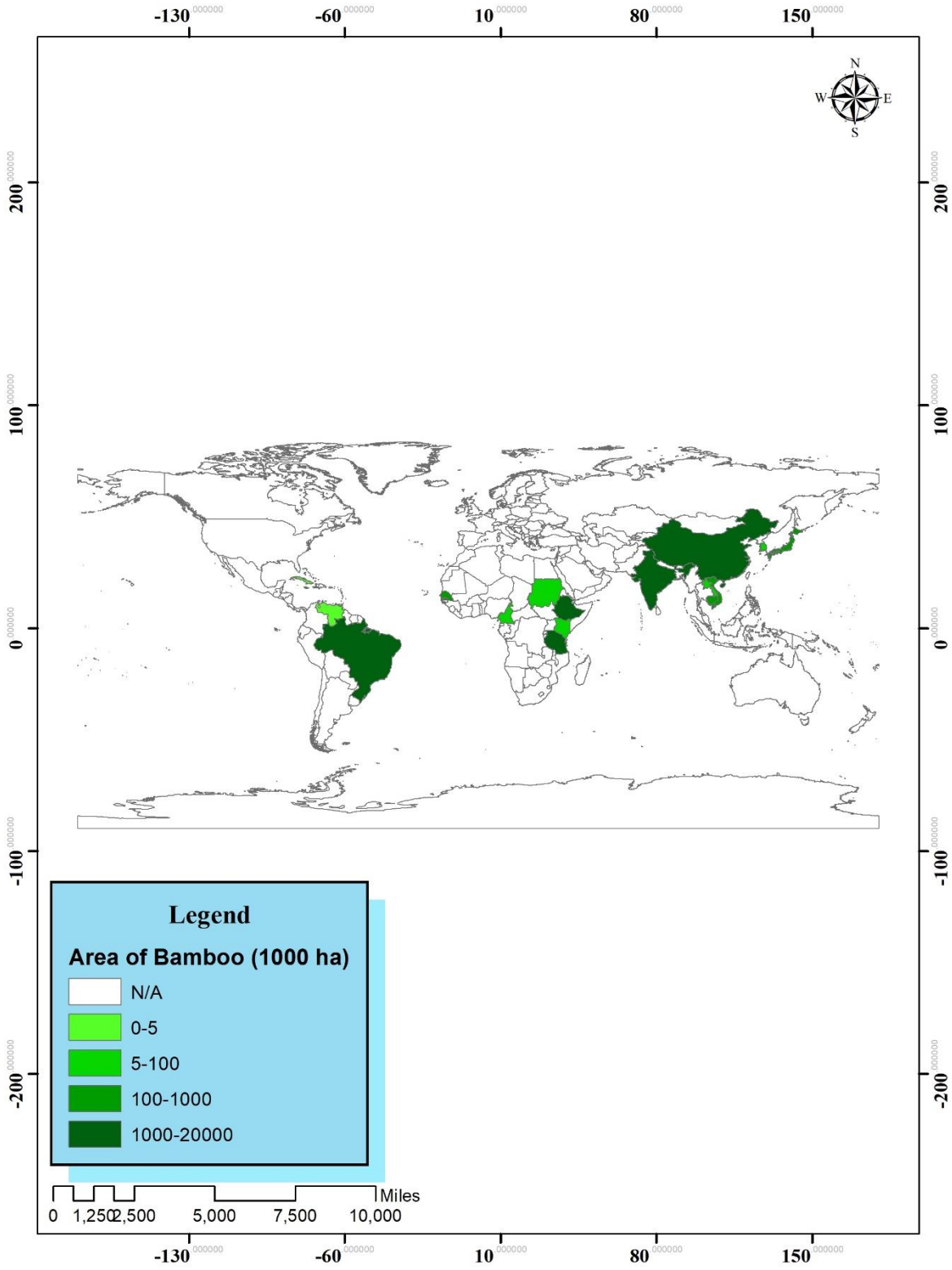


Figure 2. Area of bamboo across the world (1000 ha): 2020.

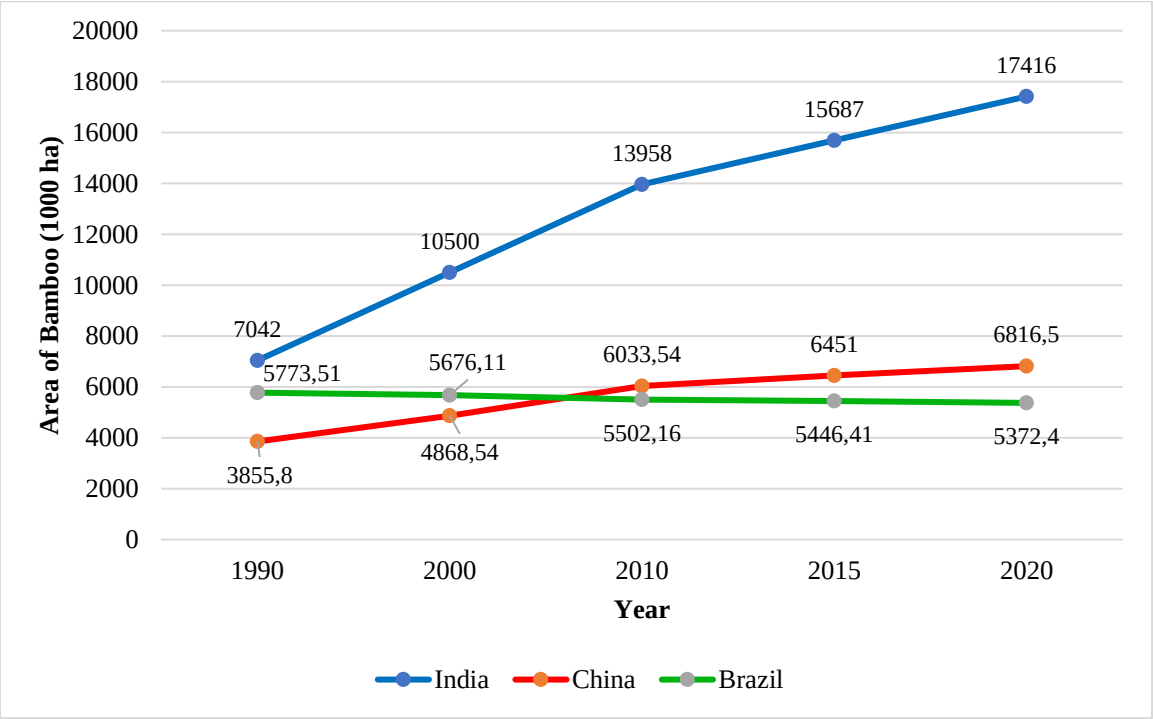


Figure 3. Trends in area of bamboo in the dominant nations: (1990-2020).

3.2 Estimation of Bamboo Resources Across Brazilian States

The investigation into Brazil's bamboo resources, as depicted in Figure 4 and Table 3, is founded on a multifaceted approach combining secondary data, expert interviews, and validations through technical visits and imagery analysis via Google Maps. The estimated area of bamboo per state, as listed in the provided data, underscores significant regional variations. For instance, Acre showcases a substantial bamboo presence with an estimated 4,563,600 hectares (Carmo et al., 2017), indicative of remote sensing analysis accuracy and a possibly undervalued bamboo resource base in other regions. the data for other states were primarily derived from interviews, questionnaires, consulting reports, and expert consultations.

Analysis suggests that Amazonas, with an estimated 602,100 hectares, and Mato Grosso do Sul with 40,000 hectares, are other key states with substantial bamboo areas. Conversely, states like Espírito Santo and Rio de Janeiro reflect minimal bamboo areas, which could be attributed to either an actual scarcity or limitations in the data collection method, particularly in distinguishing bamboo in mixed-vegetation landscapes.

It’s important to note that for regions such as the state of Pará, no specific data could be obtained through the methodologies employed. This absence of data does not necessarily imply a lack of bamboo resources in Pará; in fact, remote sensing data suggests the presence of bamboo in certain areas of the state. The challenges in remote sensing analysis, particularly in regions with dense forest coverage and complex landscapes, make it difficult to accurately quantify these resources.

The estimated bamboo coverage across the studied regions in Brazil stands at roughly 5.26 million hectares. It's important to recognize that these estimates are conservative. Given the limitations in detection capabilities, especially for bamboo populations beneath dense forest canopies or within complex terrain, the actual bamboo coverage is likely to be higher. Therefore, these figures should be seen as baseline estimates, with the real possibility that the extent of bamboo resources in Brazil could be significantly greater once more sophisticated remote sensing techniques and comprehensive field verifications are employed.

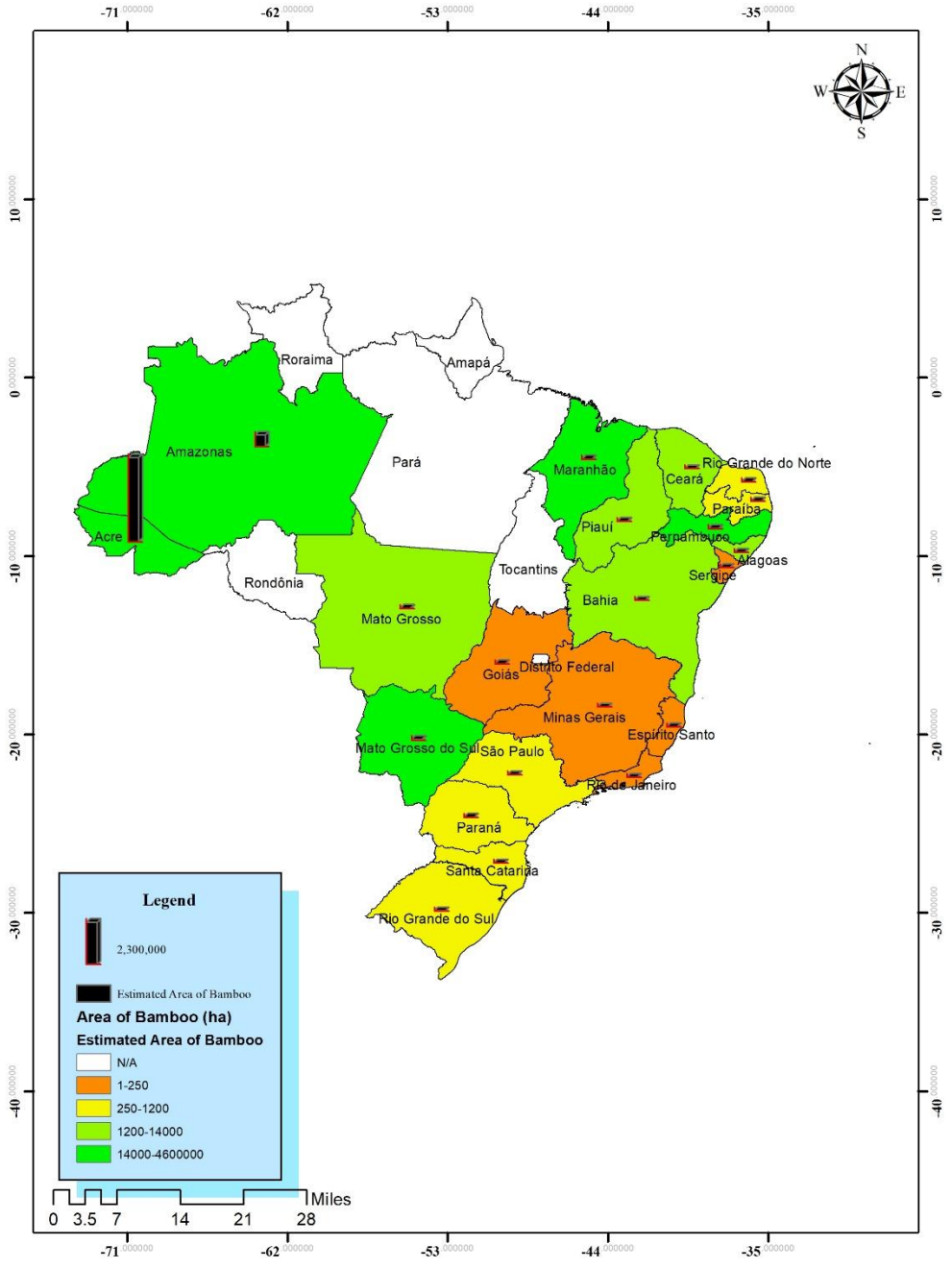


Figure 4. Bamboo Distribution and Estimated Coverage in Brazilian States.

Within the scope of this research, a significant portion of the data was sourced from small-scale bamboo growers, with many of the interviewed farms being less than one hectare in size. These

small farms contribute to the patchwork of bamboo cultivation across the country, alongside natural bamboo forests that dot the landscape. Additionally, substantial bamboo plantations have been established by larger commercial groups, some of which are cultivated on a grand scale for industrial purposes. For instance, in the Northeast region of Brazil, there are forty thousand hectares dedicated to the cultivation of *Bambusa vulgaris* to produce cellulose pulp, indicating the strategic importance of bamboo within commercial and industrial sectors.

Table 3. Estimated area of bamboo in each Brazilian state.

Brazilian State	Total Area (Hectare)	Estimated Area of Bamboo (Ha)
Acre	16,417,300	4,563,600
Alagoas	2,783,000	1382
Amapá	14,247,000	NA
Amazonas	155,925,500	602,100
Bahia	56,476,000	3504
Ceará	14,889,400	1916
Espírito Santo	4,607,400	2
Goiás	34,024,200	97
Maranhão	32,965,100	15387
Mato Grosso	90,320,800	14,000
Mato Grosso do Sul	35,714,200	40,000
Minas Gerais	58,651,300	92
Pará	124,587,000	NA
Paraíba	5,646,700	1038
Paraná	19,929,800	314
Pernambuco	9,806,700	14,202
Piauí	25,175,500	4128
Rio de Janeiro	4,375,000	73
Rio Grande do Norte	5,280,900	971
Rio Grande do Sul	28,170,700	356
Rondônia	23,775,400	NA
Roraima	22,364,400	NA
Santa Catarina	9,573,000	270
São Paulo	24,821,900	395
Sergipe	2,193,800	242
Tocantins	27,742,300	NA
TOTAL	850,464,300	5,264,069

3.2.1 Methodological Challenges in Bamboo Area Identification for Brazil's Inventory Analysis

Identifying the extent of bamboo areas in Brazil presented numerous methodological challenges. Reliance on individual reports about bamboo quantities on their lands introduces subjectivity that may not accurately reflect the true scale of bamboo presence. Although valuable, this approach required a rigorous cross-verification process to align anecdotal evidence with quantifiable data. This was partly achieved through technical site visits, such as those conducted in the state of São Paulo (Figure 5).

Figure 5. Field Verification: Assessing Bamboo Abundance on Location (example from the state of Sao Paulo).

Role of Remote Sensing in Bamboo Resource Estimation

While remote sensing was instrumental, it only served to validate the presence of bamboo and support area estimations reported by local informants and prior research. The integration of Google Maps and remote sensing tools offered only a partial view of the bamboo stands due to factors like canopy coverage and visual ambiguity. Canopy coverage often obscured the bamboo species under the canopy of taller trees, rendering them invisible from an aerial view. Moreover, the identification process faced hurdles due to color variations from light reflection, diverse bamboo heights, different species, and the density of foliage, which is evident in the Figure 6. This figure is presenting the Aerial View of Bamboo Stand (Figure 6, A1 and B1), and Ground-Level View of Bamboo Stand (Figure 6, A2 and B2) in two locations.

These factors collectively affected the precision of our bamboo area estimations. To enhance the accuracy of our findings, a combination of further ground-level data collection and advanced remote sensing is recommended.

Figure 6. Comparative Perspectives of Bamboo Stand Analysis: Aerial and Ground-Level Observations.

However, the data for Acre was derived from a detailed remote sensing analysis outlined in a separate study (Carmo et al., 2017), which we've addressed in our report. While we've incorporated data from existing literature for regions like Acre, the overall bamboo distribution figures in our study are conservative estimates, suggesting the actual numbers may be higher.
These challenges suggest that the current figures likely undervalue the real distribution of bamboo in Brazil. To remedy this, a combination of enhanced remote sensing, increased on-ground interviews, and improved image analysis techniques are recommended for future studies to provide a more comprehensive bamboo resource inventory.

3.3 Bamboo Diversity and Distribution Across Brazilian Phytogeographic Regions

Literature Review on Bamboo Diversity in Brazil

This section reviews the existing literature on the diversity and distribution of bamboo species across Brazil. Previous studies such as those by Greco et al. (2015) and Londoño (2002) have been cited to provide a historical perspective on the classification and growth patterns of bamboo in various Brazilian phytogeographic regions. The emphasis is on the significant increase in the number of species and genera identified over time, as well as the distinct biodiversity of different regions, especially the Atlantic Rainforest and the Cerrado.

According to (Greco et al., 2015), Brazil was home to a total of 256 native taxonomic groups within the *Bambusoideae* in 2015 (See Appendix 1 and Appendix 2). Among these, there were 251 native species, along with two subspecies (*Chusquea mimosa subsp. australis* and *Guadua tagoara var. glaziovii*), and three distinct varieties (*Chusquea capituliflora var. pubescens*, *C. tenuiglumis var. laxiuscula*, and *C. tenuiglumis var. subcilindrica*). In this regard, (Londoño, 2002) argued that Brazil was home to 34 bamboo genera and approximately 232 species in 2004, with a few of them yet to receive formal descriptions.

Interestingly, both trib. *Olyreae* and trib. *Bambuseae* comprised 17 genera documented within the country in 2015 (Zappelini et al., 2020). The Northeast region, at 73.5%, stood out as the most diverse region in terms of genera, hosting 25 out of the 34 identified genera (as shown in Table 4 and Figure 7) (Zappelini et al., 2020). This diversity is primarily concentrated in the remaining areas of the Atlantic Rainforest, extending along the East coast from South to North. This

phytogeographical region is home to 203 species, comprising 64% of total species identified in Brazil (Jardim Botânico do Rio de Janeiro, 2023). Before, as noted by (Londoño, 2002), Atlantic Rainforest was known to contain 22 genera and 62 species, although (Filgueiras & Gonçalves, 2004) suggested that the Atlantic Forest harbored 151 species, representing 65% of diversity among the main biomes (See Table 5). Therefore, bamboo species are not uniformly spread across the nation. When they are organized to align with the major phytogeographic domains in the country, as indicated in Table 5, it becomes apparent that the Atlantic Forest is significantly the most diverse biome, followed by Amazonia and Cerrado.

The North and Southeast regions exhibited nearly the same number of genera in 2015, with percentages of 61.8% and 61.7%, respectively. Both the Center-west and South regions shared an equal count of 13 genera, contributing to 38.2% of the total genera found in Brazil.

It's worth noting that the North region, represented by the Amazon, is believed to be significantly richer in genera than the Southeast. However, conducting studies in the North region has been severely limited due to the enormous logistical challenges posed by its vast size and the lack of communication infrastructure.

The geographical features of the Southeast region also support the genetic diversity of its wildlife and plant life. This area encompasses thriving Atlantic Rainforests and mountain ranges stretching from sea level to nearly 3000 meters in elevation. Some areas in this region receive annual rainfall of up to 2000 mm (Dereczynski et al., 2009).

Table 4. Distribution of *Olyreae* and *Bambuseae* derived genera across the Brazilian regions in 2015.

Regions	Olyreae Genera	Bambuseae Genera	Total Genera	(%) Genera
North	11	10	21	61.8
Center-west	6	7	13	38.2
Northeast	15	10	25	73.5
Southeast	10	11	21	61.7
South	5	8	13	38.2
Brazil	17	17	34	100

Source: Adapted from (Greco et al., 2015).

Current Study Results on Bamboo Distribution

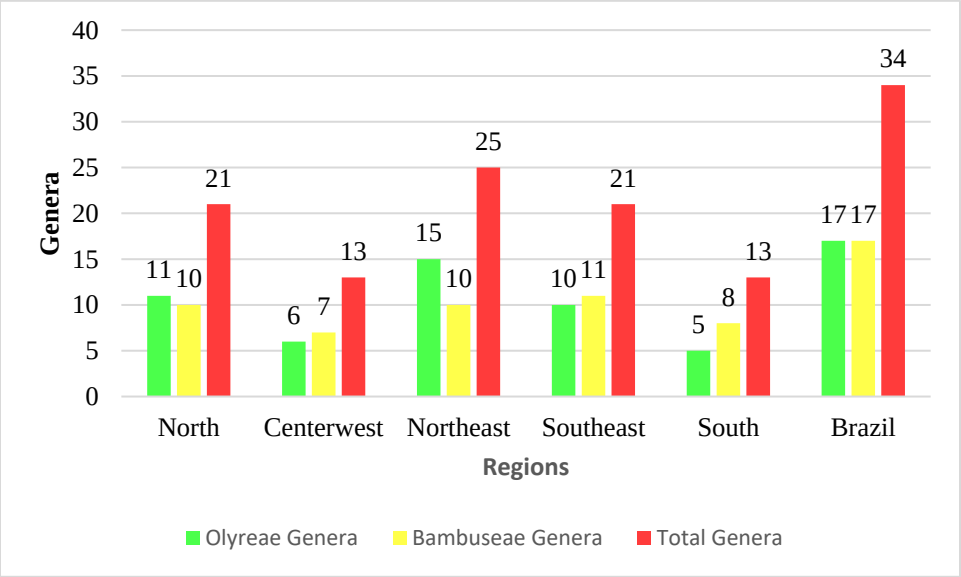
Here, the section presents the findings of this study, detailing the current state of bamboo diversity and distribution as extracted from the REFLORA platform. It contrasts the findings with past data and highlights the dynamic changes in the distribution patterns of bamboo species. This section also discusses the challenges and limitations faced in the Northern region and the high degree of endemism within Brazilian bamboo genera. Tables and figures derived from the study illustrate the distribution of bamboo species and genera across Brazilian states, providing a comprehensive view of the status of bamboo biodiversity in the country.

According to the data gathered from REFLORA platform in this research, Brazil hosts a total number of 316 species within the *Bambusoideae* Luerss. subfamily, with 52 genera, including 3 subspecies and 2 varieties (Jardim Botânico do Rio de Janeiro, 2023).

Table 5. Distribution of bamboo species within the major phytogeographic domains of Brazil.

Biome	This study		2004	
	Total Species	**(%) Species**	**Total Species**	**(%) Species**
Atlantic Forest	203	64	151	65
Amazonia	92	29	60	26
Cerrado	34	11	21	9
Caatinga	11	3		
Pantanal	6	2		
Pampa	5	2		
Total	316	100	232	100

Source: Data of this study are extracted *from REFLORA platform and data of 2015 are* Adapted (Greco et al., 2015).



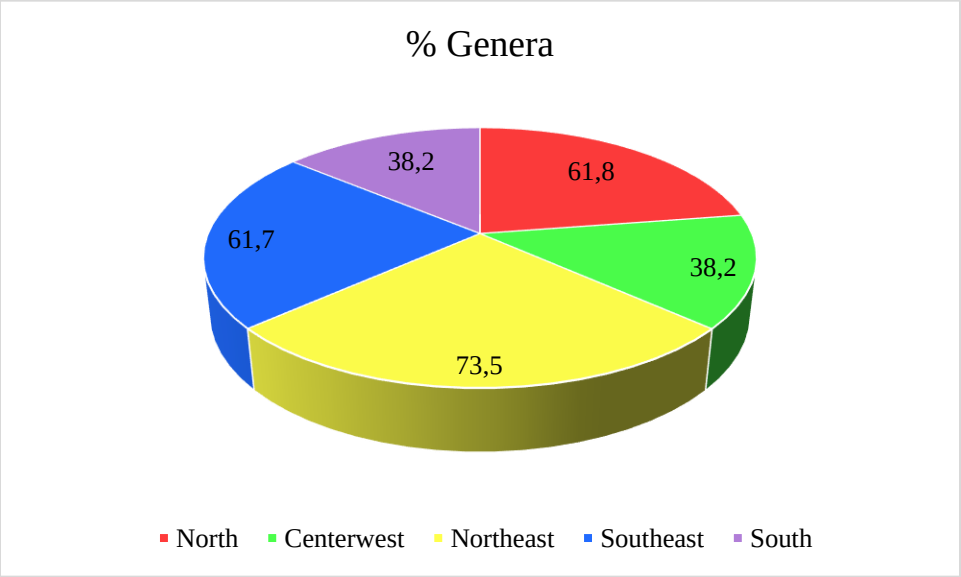


Figure 7. Distribution of *Olyreae* and *Bambuseae* derived genera across the Brazilian regions in 2015.

In 2015, the Southeast region, with 46.9% of the species (as detailed in Table 6), stood out as the most species-rich area. During an eight-year period, this ratio grew by 11% and made the Southeast region the most diverse area in Brazil, accounting for more than a half of the species (57.9%) in 2023 (As depicted in Table 6 and Figure 8). It's important to note that the flora of the North region (representing the Amazon) remains relatively underexplored, accounting for 34.4% and 29.1% of the species, respectively. Furthermore, expansive bamboo forests, known as "Tabocais" in Brazil and "Pacales" in Peru (Yeasmin et al., 2015), occupy a substantial territory

in the Brazilian state of Acre extending into Peru and Bolivia, with an estimated area of 600,000 hectares.

In 2015, *Olyreae* species (61) significantly outnumbered *Bambuseae* species (27) within the North region, while this pattern is reversed in the South and Southeast regions (As illustrated by Table 6). North and Northeast regions shared almost the same number of species in 2015 with the ratio of 34.4% and 34%, respectively. Nevertheless, the number of identified species in both of these regions experienced a moderate rise in 2023, reaching 92 in the North and 96 in the Northeast (See Table 6, Figure 8 and Figure 9).

In 2015, The regions of Center-west and South had the lowest levels of genus diversity at 38.2% (as indicated in Table 4 and Figure 7). Center-west also exhibits the lowest species diversity in 2015 and 2023, with a ratio of 12.1% and 13.3%, respectively (as shown in Table 6, Figure 8 and Figure 9). This could be attributed to the extensive presence of the savannah, known as "Cerrado" in Brazil, in that region. Based on the results of (Londoño, 2002), Cerrado ecoregion accounted for the lowest number of species among the main biomes of Brazil with only 21 out of 232 known species. Nonetheless, it is worth mentioning that the authors did not take other major biomes, such as Caatinga, Pantanal and Pampa into account. In accordance with (Jardim Botânico do Rio de Janeiro, 2023), Cerrado accounts for the third highest number of species among the phytogeographic domains at 34 out of 316 identified species, staying ahead of Caatinga, Pantanal and Pampa.

Based on the information presented in Table 8, Appendix 1 and Appendix 2, Bahia state (with 78 species), Minas Gerais state (with 66 species) and São Paulo state (with 65 species) emerged as the most abundant regions in terms of bamboo species in 2015. In 2023, São Paulo stands for the highest diversity of species among the Brazilian states, with a total number of 112 species, followed by Minas Gerais and Bahia with 91 and 85, respectively.

Table 6. Distribution of *Olyreae* and *Bambuseae* derived species across the Brazilian regions.

Regions	2015				This study	
	Olyreae Species	**Bambuseae Species**	**Total Species**	**(%) Species**	**Total Species**	**(%) Species**
North	61	27	88	34.4	92	29.1
Center-west	16	15	31	12.1	42	13.3
Northeast	43	44	87	34	96	30.4
Southeast	24	96	120	46.9	183	57.9
South	9	54	63	24.6	75	23.7
Brazil	93	163	256	100	316	100

Source: Data from this study which are extracted from REFLORA platform and data of 2015 are Adapted from (Greco et al., 2015).

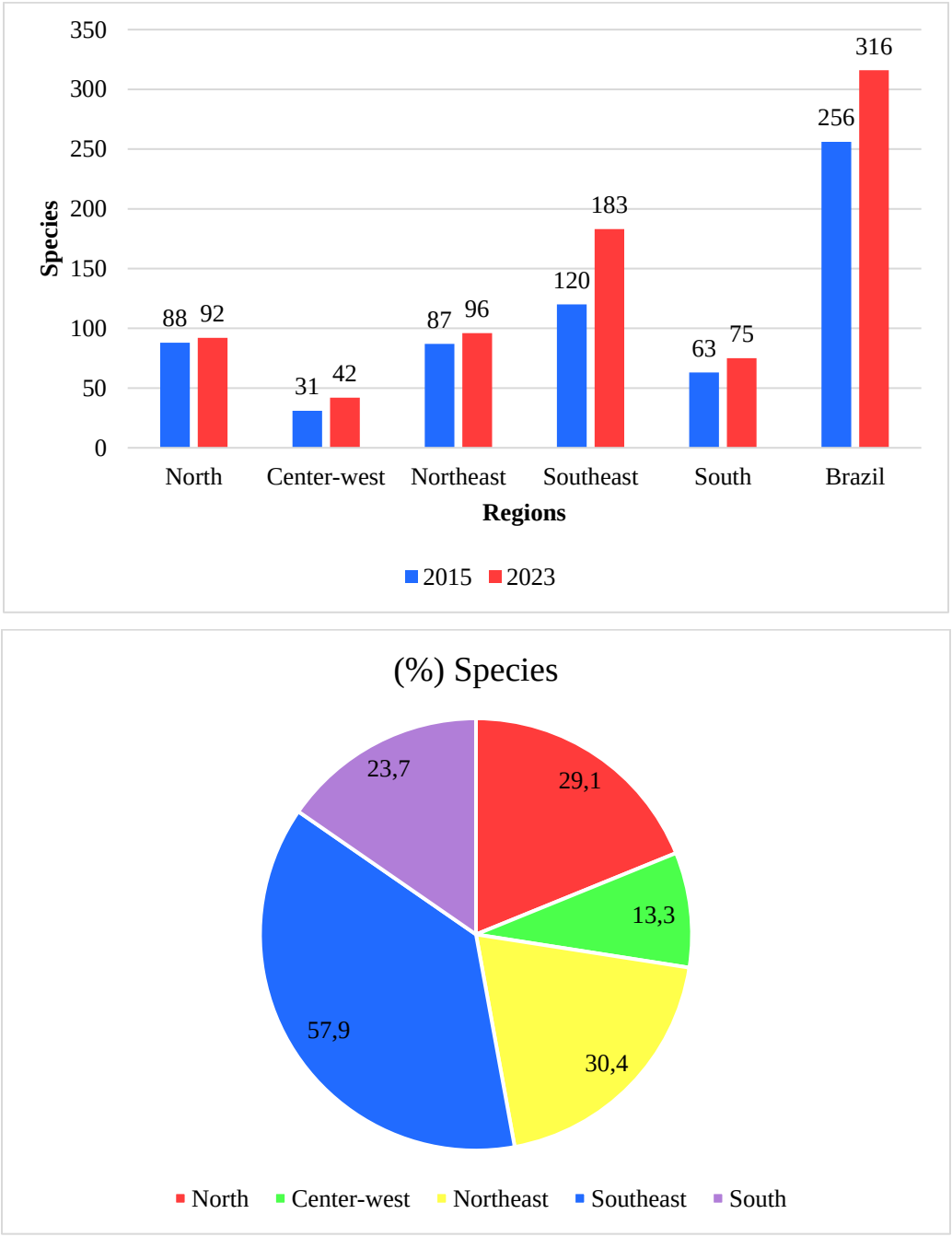


Figure 8. Distribution of *Olyreae* and *Bambuseae* species across the Brazilian regions in 2023, based on the results of this study.

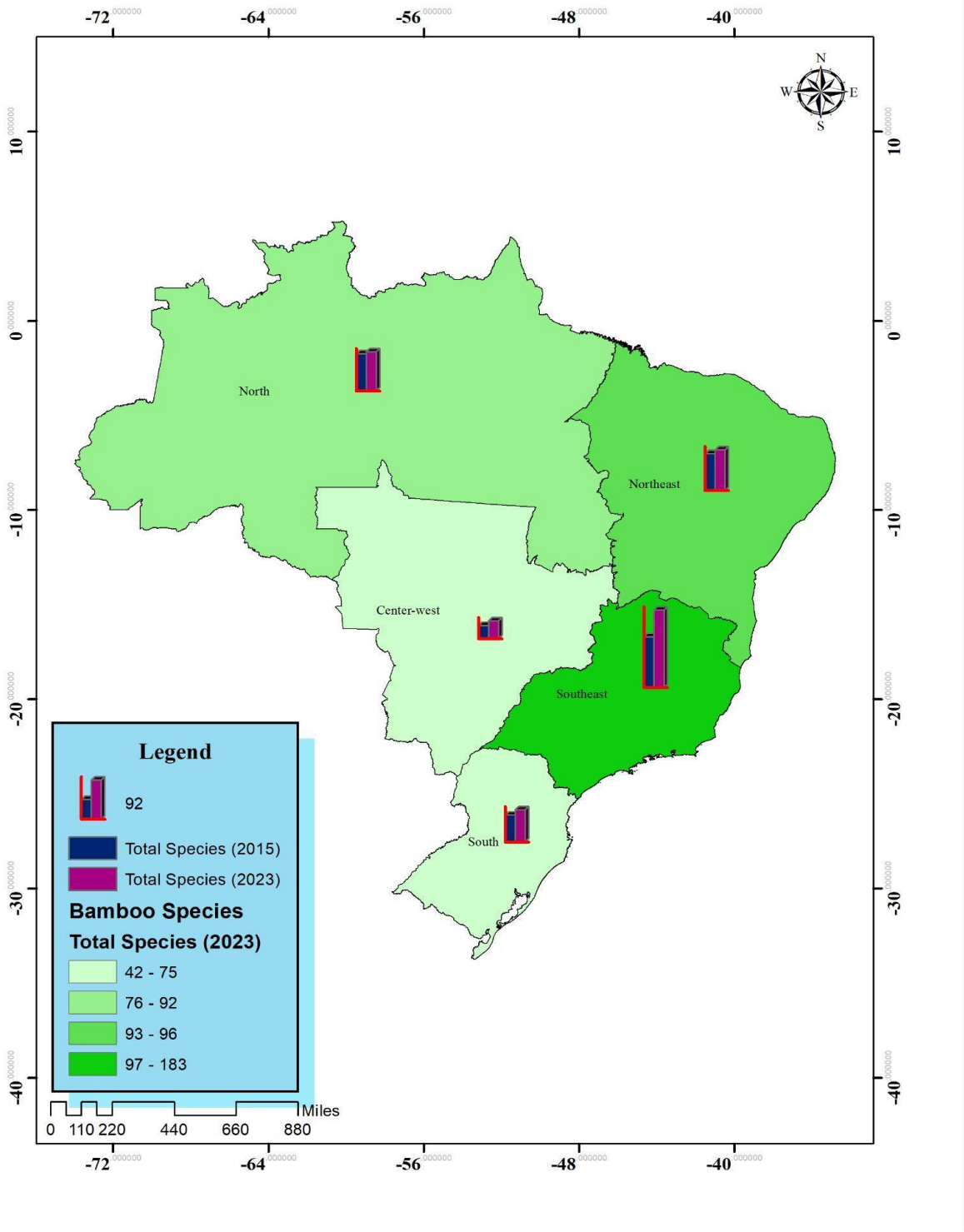


Figure 9. Distribution of bamboo species across the Brazilian regions in 2023, based on the results of this study.

As illustrated in Table 7, out of the 256 species identified in 2015, 176 of them were exclusive to Brazilian territory, with 57.4% of these endemics located in the Southeast region, totaling 101 species. According to the data extracted from the REFLORA platform in this study, Brazil hosts 189 endemic species (13 endemic genera) out of the 316 total species (52 total genera) recognized in the region. (Clark et al., 2015) argued that Brazil stood out as the nation with the most extensive variety of bamboo species and the highest proportion of endemic woody bamboo species, with 137 species (32% of all bamboo species in Latin America) and 17 genera (85% of all bamboo genera in the region). On the other hand, according to (Londoño, 2002), there were 34 genera of bamboo in Brazil, with approximately 232 species, a few of which had not yet received formal descriptions; Approximately, 174 species (constituting about 75%) were regarded as endemic to Brazil.

In 2015, the Southeast region represented not only the highest proportion of total endemic species, but also the greatest number of *Bambuseae* endemic species at 86, coincidentally. However, the highest diversity of *Olyreae* endemic species belonged to the Northeast region with 23. In contrast, the Center-west region exhibited the lowest number of endemic species, accounting for only 8.5% with 15 species (as illustrated in Table 7 and Figure 10). In 2015, The South region presented the lowest diversity for the *Olyreae* tribe, with only 9 species identified (Table 6), and just one of them being endemic (as indicated in Table 7 and Figure 10). The most widely encountered species, present in nearly all Brazilian states, are *Olyra latifolia* and *Parodiolyra micrantha*, both herbaceous plants belonging to the *Olyreae* tribe (as detailed in Appendix 1).

Table 7. Distribution of *Olyreae* and *Bambuseae* derived endemic species across the Brazilian regions in 2015.

Regions	Olyreae Endemic Species	Bambuseae Endemic Species	Total Endemic Species	% Endemic Species
North	15	8	23	13
Center-west	6	9	15	8.5
Northeast	23	41	64	36.3
Southeast	15	86	101	57.4
South	1	44	45	25.5
Brazil	43	133	176	100

Source: Adapted from (Greco et al., 2015).

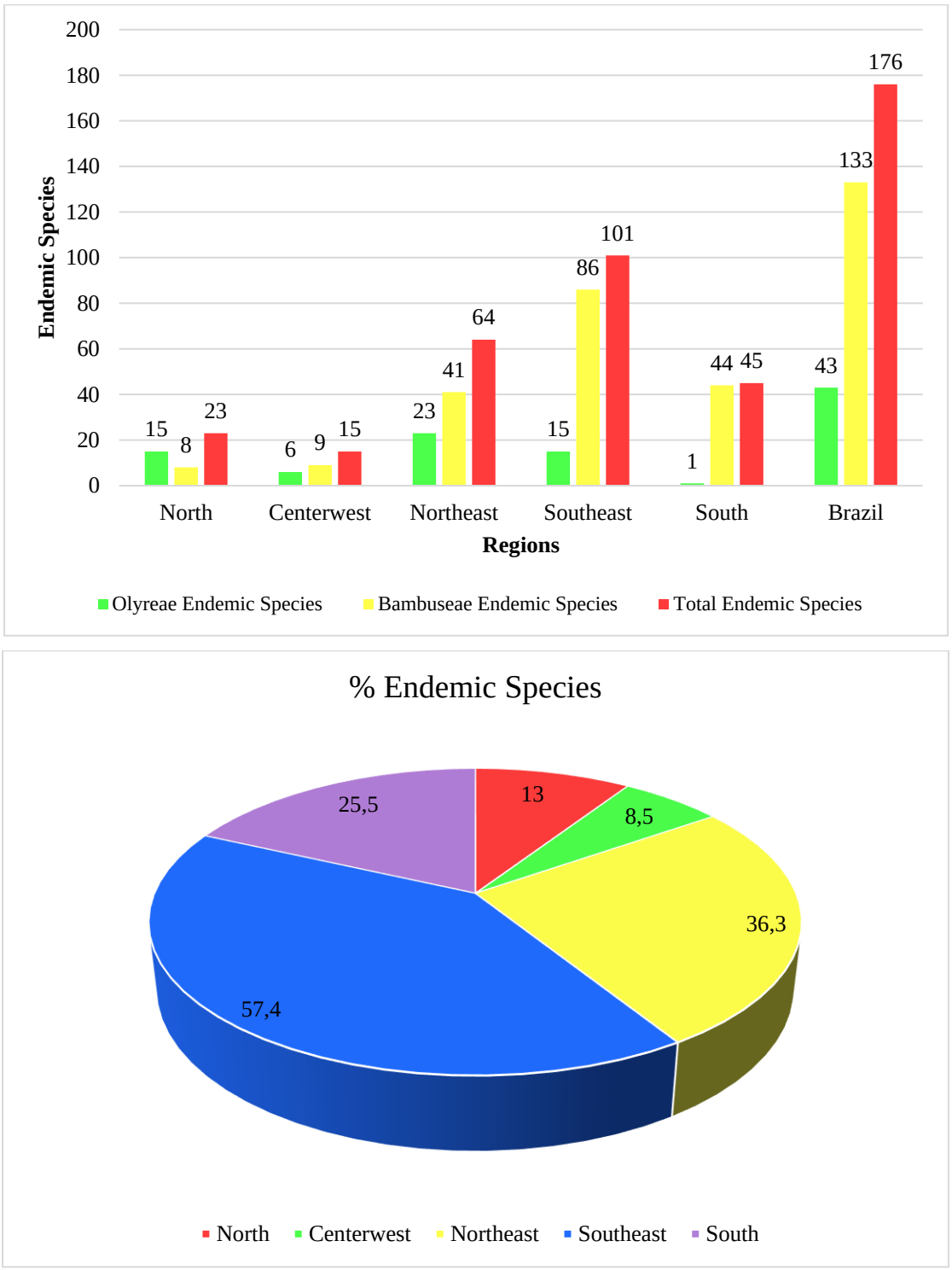


Figure 10. Distribution of *Olyreae* and *Bambuseae* derived endemic species across the Brazilian regions in 2015.

Table 8 represents the distribution of *Olyreae* and *Bambuseae* species across the states in Brazil and Figure 11 depict the geopolitical map of Brazil showing the diversity of species in 26 Brazilian states. As it is apparent, the state of Pará stood for the highest number of *Olyreae* species (35 species) in 2015, followed by the states of Amazon and Bahia (34 species). However, Minas Gerais accounted for the highest count of *Bambuseae* species with 58 in total, closely followed by the state of São Paulo at 55.

In 2015, the native species endemic to Brazil were primarily concentrated in the Southeast region with 101 species and the Northeast region with 64 species, predominantly in the states of Bahia, boasting 61 Endemic species, Minas Gerais with 54, and São Paulo with 50. These states, among the 26 in Brazil, are the ones with the highest level of endemism (as indicated in Table 8). Nevertheless, the primary region for the distribution of bamboo lies within the Atlantic rainforest, located along the coast, which experiences more consistent rainfall throughout the year. This biome is where most species found in the South, Southeast, and Northeast regions can be encountered.

It is worth noting that alongside Piauí and Tocantins, the states of Alagoas, Paraíba and Rio Grande do Norte also indicated limited diversity in 2015, with only two species identified in each of these states. In the state of Tocantins, there were no documented species of *Bambusoideae*. Piauí was another state in which no *Bambusoideae* species had been documented, likely due to insufficient collection efforts (See Table 8). However, based on the latest data gathered by (Jardim Botânico do Rio de Janeiro, 2023), an equal number of 5 total species have been discovered in the states of Piauí and Tocantins so far. Instead, the state of Rio Grande do Norte accounts for the lowest diversity of species in 2023, with only 4 species available.

Brazil is recognized as one of the nations with the most significant occurrence of endemism globally, particularly in genera like *Aulonemia*, *Merostachys*, and *Chusquea* (See Appendix 2). It holds the distinction of having the highest count of endemic species among all countries in the Americas (Judziewicz et al., 1999).

Among the *Bambuseae* genera, *Merostachys* (43 species) and *Chusquea* (45 species) were the most prevalent in 2015, and they also had the highest number of endemic species, with 41 and

42 species, respectively (See Table 9, Figure 12 and Appendix 2). In the *Olyreae* tribe, *Pariana* (29 species) and *Olyra* (20 species) were the most diverse genera (See Table 9 and Figure 12). In terms of endemics, *Pariana* was also the most prolific genus with 10 endemic species, followed by Raddia with 9 species (See Appendix 1).

Table 8. Distribution of *Olyreae* and *Bambuseae* derived species across the Brazilian states.

States	2015				This study, 2023
	Olyreae	Bambuseae	Endemic	Total Species	Total Species
Acre	14	4	1	18	31
Alagoas	2	0	0	2	8
Amapá	13	0	2	13	30
Amazonas	34	19	10	53	57
Bahia	34	44	61	78	85
Ceará	6	0	3	6	9
Distrito Federal	5	8	6	13	22
Espírito Santo	16	15	24	31	65
Goiás	5	12	9	17	24
Maranhão	12	1	3	13	16
Mato Grosso	10	3	6	13	24
Mato Grosso do Sul	6	4	3	10	17
Minas Gerais	10	58	54	66	91

Pará	35	6	10	41	55
Paraíba	2	0	1	2	6
Paraná	5	27	29	42	53
Pernambuco	9	0	4	9	12
Piauí	0	0	0	0	5
Rio de Janeiro	14	47	49	61	71
Rio Grande do Norte	2	0	1	2	4
Rio Grande do Sul	4	28	20	32	42
Rondônia	7	5	7	12	21
Roraima	8	3	1	11	17
Santa Catarina	4	40	37	44	62
São Paulo	10	55	50	65	112
Sergipe	4	0	2	4	6
Tocantins	0	0	0	0	5

Source: Data of 2023 are extracted from REFLORA platform and data of 2015 are adapted from (Greco et al., 2015).

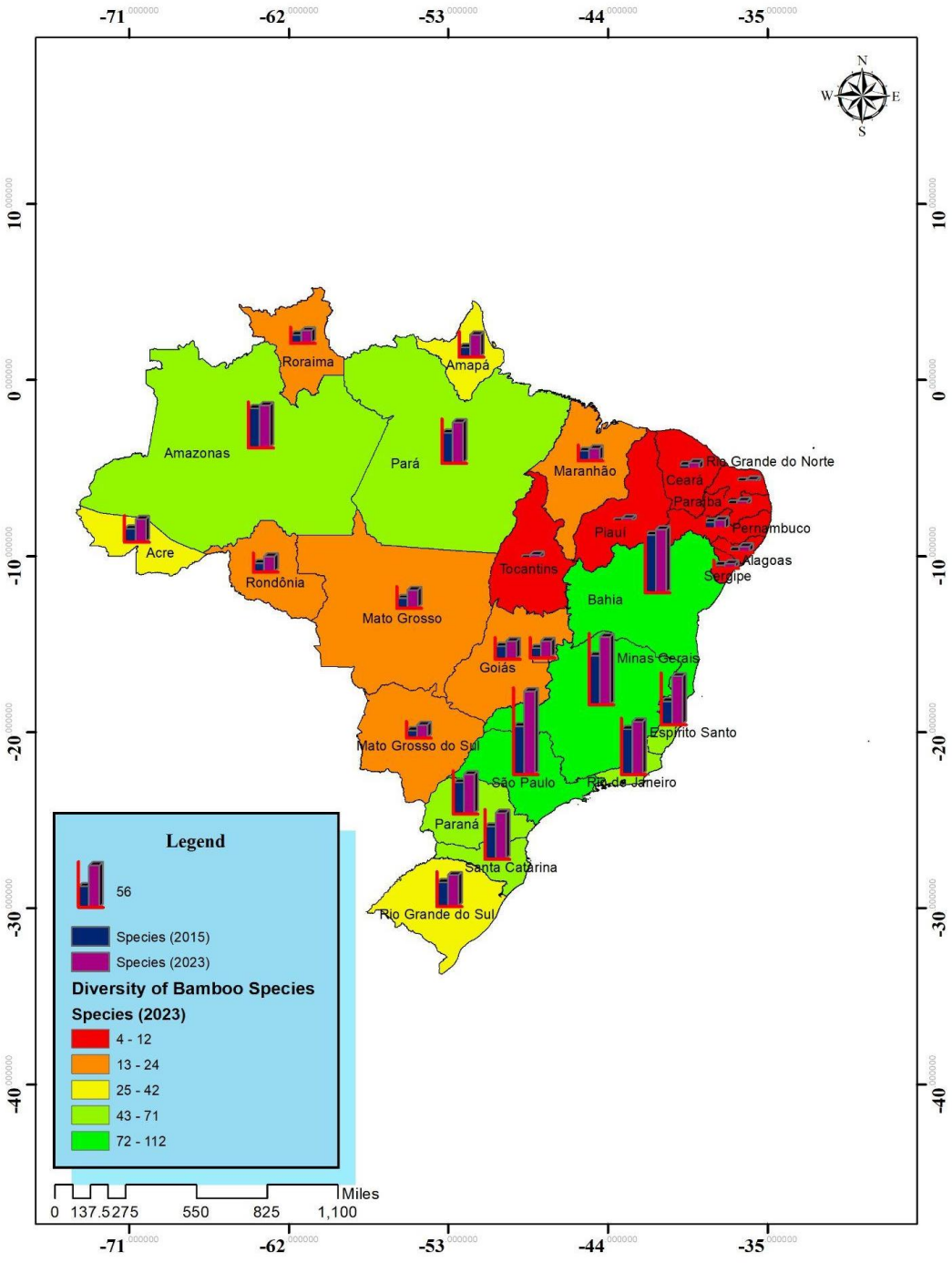


Figure 11. Diversity of bamboo species across the Brazilian states in this study.

Table 9. Distribution of *Olyreae* and *Bambuseae* genera in Brazil and across the globe in 2015.

Tribe	Genera	Species in Brazil	Species in the World
Olyreae	Agnesia Zuloaga & Judz.	1	1
	Arberella Soderstr. & C. E. Calderón	2	7
	Cryptochloa Swallen	2	8
	Diandrolyra Stapf*	3	3
	Eremitis Döll*	3	3
	Froesiochloa G. A. Black	1	1
	Lithachne P. Beauv.	2	4
	Olyra L.	20	24
	Pariana Aubl.	29	29
	Parianella Hollowell, F. M. Ferreira & R. P. Oliveira*	2	3
	Parodiolyra Soderstr. & Zuloaga	4	4
	Piresia Swallen	5	5
	Raddia Bertol.	9	11
	Raddiella Swallen	5	8
	Rehia Fitjen	1	1
	Reitzia Swallen*	1	1
	Sucrea Soderstr.*	3	3
Bambuseae	Actinocladum McClure ex Soderstr.	1	1
	Alvimia C. E. Calderón ex Soderstr. & Londoño*	3	3
	Apoclada McClure*	1	1
	Arthrostylidium Rupr.	4	32
	Athroostachys Benth.*	1	1
	Atractantha McClure	6	6
	Aulonemia Goudot	16	44
	Cambajuva P. L. Viana, L. G. Clark & Filg.*	1	1
	Chusquea Kunth	45	163
	Colanthelia McClure & L. B. Sm.	6	6

	Eremocaulon Soderstr. & Londoño	4	4
	Filgueirasia Guala*	2	2
	Glaziophyton Franch.*	1	1
	Guadua Kunth	18	27
	Merostachys Spreng.	43	49
	Myriocladus Swallen	4	12
	Rhipidocladum McClure	2	15

Sources: Adapted from (Greco et al., 2015; Londoño, 2002).

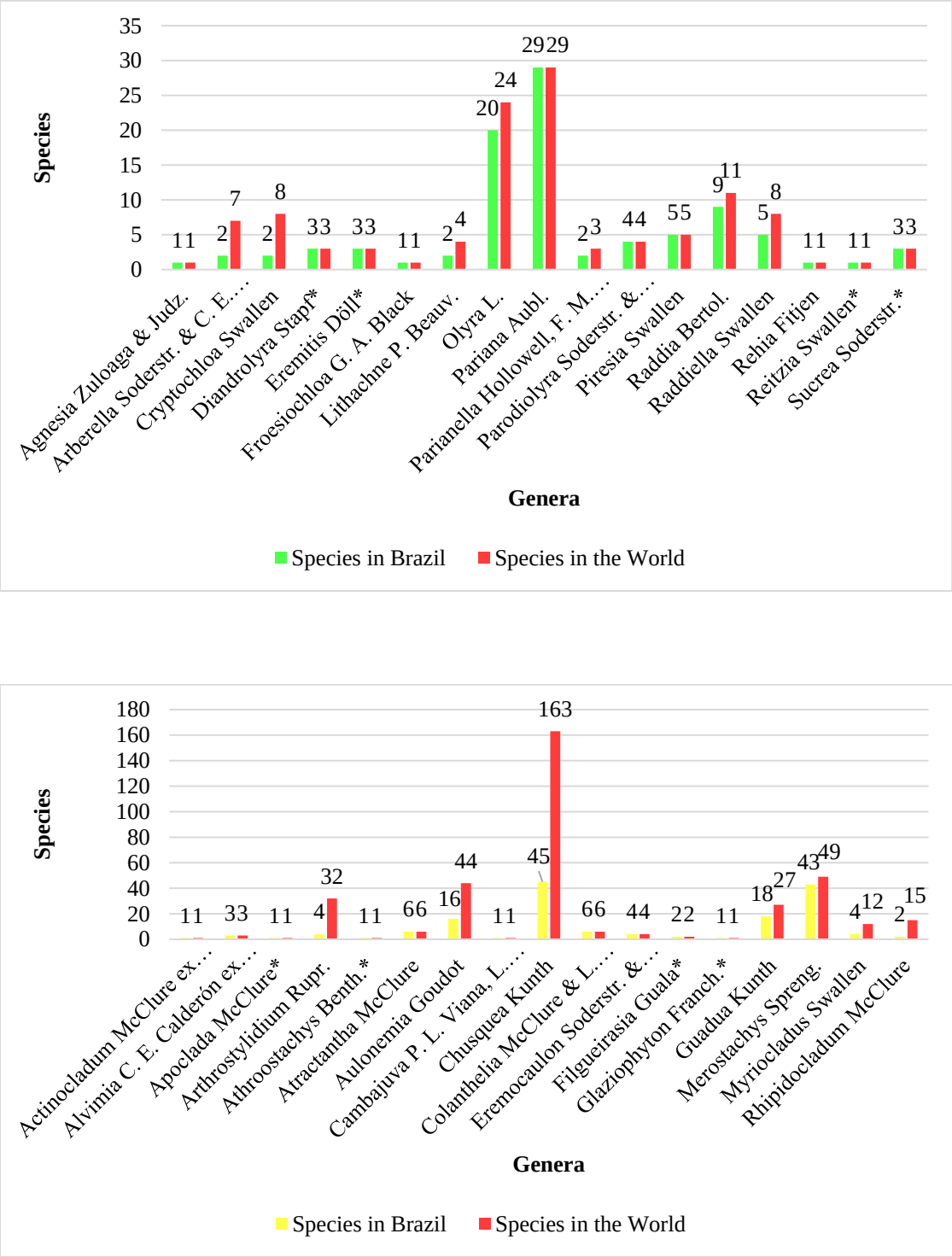


Figure 12. Distribution of *Olyreae* (top) and *Bambuseae* (bottom) derived genera in Brazil and across the globe in 2015.

A considerable number of bamboo species are cultivated in Brazil. While maintaining an exact inventory of all the species across the country's vast expanse is nearly impossible, Table 10 serves as an initial attempt to compile the most frequently encountered species under cultivation and confirms the result reported on (Londoño, 2002). In this table, "common" implies that it is observed in botanical gardens, research institutions, and private gardens, and "widespread" signifies that the species thrives in various regions where the climate is conducive to its growth. Most of these species are exotic and grown for ornamental purposes, although some serve as resources for erosion control, housing construction, the paper industry, and various agricultural applications. Table 10 currently lists 8 species, but the number is expanding at a swift pace as nurseries and individual cultivators show increasing interest in this commerce.

Table 10. Most common bamboo species cultivated in Brazil.

Binomial	Common name(s)	Obs.
Bambusa vulgaris Schrad. ex J.C. Wendl.	Bambu, bambu comum	Widespread
Sinoarundinaria falcata (Nees) C.S.Chao & Renv.	Bambu-de-jardim	Widespread
Phyllostachys aurea Rivière & C. Rivière	Bambu amarelo, bambu de jardim, bambu- vara-de-pescar, bambu dourado; cana-da-India	Widespread
Dendrocalamus asper (Schult. & Schult. f.) Backer ex K. Heyne	Bambu balde, bambu gigante	Common
B. multiplex (Lour.) Raeusch. ex Schult. & Schult. f.	Bambu-multiplex, bambu-folha-de-samambaia	Common
P. bambusoides Siebold & Zucc.	Bambu japonês	Common
Pseudosasa japonica (Siebold & Zucc. ex Steud.) Makino	Bambu metaque	Common
Sasa fortunei (Van Houtte) Fiori	Bambu-miniatura	Common

4. Conclusion

The Estimation and Analysis of Bamboo Resources and Species Distribution in Brazil has provided a detailed snapshot of the nation's bamboo resources. Not only has it revealed the extent and diversity of bamboo species across various regions, with a significant 316 species spanning 52 genera, but it has also shed light on the challenges of accurately estimating the total area of bamboo, especially across the states of Acre, Amazonas, and Mato Grosso do Sul. These states demonstrate considerable yet potentially underestimated bamboo coverage, with conservative figures suggesting an area of approximately 5.26 million hectares.

Efforts to quantify bamboo resources in Brazil have been supported by crucial platforms like "Mapa Bambuzeiros" and "REFLORA." "Mapa Bambuzeiros" enhances community involvement, allowing individuals to contribute data on bamboo locations, while "REFLORA" has been instrumental in documenting the diversity of bamboo species, significantly enriching our understanding of biodiversity-rich areas such as the Northeast. These platforms have played pivotal roles in our efforts to refine our understanding of bamboo distribution.

However, despite these achievements, the process faced methodological challenges, including variations in data collection methods and the difficulties of remote sensing in dense, complex landscapes. There is a noticeable disparity in bamboo presence across states, with minimal areas reported in Espírito Santo and Rio de Janeiro contrasted with extensive coverage in Acre. This situation underscores the need for enhanced data gathering techniques, such as advanced remote sensing, on-ground interviews, and field verifications. Implementing these measures is essential for accurately determining the true scale of bamboo resources, which are crucial for the agricultural and industrial sectors of Brazil. A critical challenge that remains is ensuring the reliability of data concerning the total bamboo area, a task these platforms help address by providing more accurate and comprehensive data coverage.

As we advance, the next phase of research will build upon the groundwork laid by this initial inventory. Future studies are recommended to incorporate an expanded use of advanced techniques, which, when integrated with in-depth interviews and technical visits, will provide a richer, more detailed view of the bamboo landscape. This approach will allow for a more nuanced

understanding of the sector, necessary for developing targeted strategies for sustainable cultivation and utilization.

In conclusion, the study is a crucial step toward unlocking the potential of Brazil's bamboo sector, emphasizing the need for ongoing data accuracy enhancements and the significance of taxonomic platforms in promoting sustainable development. With further investigation, technological advancements and the support of international organization like INBAR, we can expect a more precise understanding and effective management of the country's bamboo resources.

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Appendix

Appendix 1. Tribe Olyreae: Distribution of Genera and species per geographical region and state in Brazil.

Olyreae Genera	Olyreae Species	Distribution
Agnesia Zuloaga & Judz.	*A. lancifolia* (Mez) Zuloaga & Judz.	N (PA, AM)
Arberella Soderstr. & C. E. Calderón	*A. bahiensis* Soderstr. & Zuloaga**	NE (BA), RO
	A. flaccida (Döll) Soderstr. & C. E. Calderón	N (AM, AC)
Cryptochloa Swallen	*C. capillata* (Trin.) Soderstr.	N (RR, AP, PA), NE (BA), CW (MT), SE (MG, ES, SP, RJ)
	C. unispiculata Soderstr.	N (AC)
Diandrolyra Stapf*	*D. bicolor* Stapf**	NE (BA), SE (ES, RJ)
	D. pygmaea Soderstr. & Zuloaga ex R. P. Oliveira & L. G. Clark**	NE (BA)
	D. tatianae Soderstr. & Zuloaga**	NE (BA), SE (MG, ES, SP, RJ)
Eremitis Döll*	*E. afimbriata* F. M. Ferreira & R. P. Oliveira**	SE (ES)
	E. linearifolia Hollowell, F.M.Ferreira & R.P.Oliveira**	SE (ES)
	E. magnifica F. M. Ferreira & R. P. Oliveira**	SE (MG)
	E. multiflora (R.P.Oliveira, Longhi-Wagner & Hollowell) F.M.Ferreira & R.P.Oliveira**	SE (ES)
	E. parviflora (Trin.) Calderón & Soderstr.**	NE (BA), SE (ES)

Olyreae Genera	Olyreae Species	Distribution
Froesiochloa G. A. Black	*F. boutelouoides* G. A. Black	N (AP), NE (MA)
Lithachne P. Beauv.	*L. horizontalis* Chase**	CW (MT), N (AP), NE (MA), SE (MG, ES, SP, RJ)
	L. pauciflora (Sw.) P. Beauv.	NE (CE), CW (MS), S (RS)
Olyra L.	*O. amapana* Soderstr. & Zuloaga	N (AP, AM, RO)
	O. bahiensis R. P. Oliveira & Longhi-Wagner**	NE (BA)
	O. caudata Trin.	N (RR, PA, AM, AC, RO), CW (MT)
	O. ciliatifolia Raddi	N(PA, AM, AC), NE (MA, CE, BA, SE), CW(MT, GO, DF, MS), SE(MG, SP, RJ), S (PR)
	O. davidseana Judz. & Zuloaga**	N (PA, AM)
	O. ecaudata Döll	N (PA, AM, AC), NE (BA)
	O. fasciculata Trin.	N (PA), NE (BA), CW (GO), SE (ES, SP, RJ), S (PR, SC)
	O. filiformis Trin.	NE (BA)
	O. glaberrima Raddi	NE (PE, BA), SE (ES, SP, RJ), S (SC)
	O. humilis Nees	NE (BA), CW (GO, DF), SE (MG), S (PR, RS)
	O. juruana Mez	N (PA, AC)
	O. latifolia L.	N (AP, AC), N (MA, CE, PE, BA, SE), CW (MT, MS, DF), SE (ES, SP, RJ), S (RS)
	O. latispicula Soderstr. & Zuloaga**	NE (BA)
	Olyra longifolia Kunth	N (RR, AP, PA, AM), NE (MA)
	O. loretensis Mez	N (AP, PA, AM, RO)
	O. obliquifolia Steud.	N (AP, PA), NE (MA)

Olyreae Genera	Olyreae Species	Distribution
	O. retrorsa Soderstr. & Zuloaga**	CW (MT)
	O. tamanquareana Soderstr. & Zuloaga**	N (AM)
	O. taquara Swallen**	N (PA), CW (MT, GO, DF, MS)
	O. wurdackii Swallen	N (AM)
Pariana Aubl.	*P. bicolor* Tutin	N (AM)
	P. campestris Aubl.	N (AP, PA), NE (MA)
	P. concinna Tutin	N (AM)
	P. distans Swallen**	N (PA)
	P. ecuadorensis Pilg.**	N (AM)
	P. gleasonii Hitchc.	N (AP)
	P. gracilis Döll	N (AM)
	P. imberbis Nees**	N (AM)
	P. intermedia Döll**	N (AP, PA, AM)
	P. interrupta Tutin	N (PA, AM)
	P. ligulata Swallen**	N (PA)
	P. lunata Nees	N (PA)
	P. maynensis Huber	N (PA, AC)
	P. modesta Swallen**	NE (MA)
	P. multiflora R. P. Oliveira, Longhi-Wagner & Hollowell**	SE (ES)
	P. nervata Swallen**	N (PA)
	P. ovalifolia Swallen**	N (PA, AM)
	P. pallida Swallen	N (AM)
	P. radiciflora Sagot ex Döll	N (PA, AM)
	P. simulans Tutin	N (AM)
	P. sociata Swallen**	NE (MA)
	P. stenolemma Tutin	N (AC)
	P. tenuis Tutin	N (AM)

Olyreae Genera	Olyreae Species	Distribution
	P. trichosticha Tutin	N (AC)
	P. ulei Pilg.	N (AM, AC)
	P. velutina Swallen	N (AM)
	P. violascens Swallen	N (AM)
	P. vulgaris Tutin	N (PA, AM, RO)
	P. zingiberina Rich. ex Döll	N (PA)
Parianella Hollowell, F. M. Ferreira & R. P. Oliveira*	*Parianella carvalhoi* (R. P. Oliveira & Longhi Wagner) F. M. Ferreira & R. P. Oliveira**	NE (BA)
	P. lanceolata (Trin.) F. M. Ferreira & R. P. Oliveira**	NE (BA)
Parodiolyra Soderstr. & Zuloaga	*P. lateralis* (C. Presl ex Nees) Soderstr. & Zuloaga	N (PA, AM, RR)
	P. luetzelburgii (Pilg.) Soderstr. & Zuloaga	N (RR, AP, PA, AM), NE (MA), CW (MT)
	P. micrantha (Kunth) Davidse & Zuloaga	N (RR, PA, AM, AC), NE (MA, PE, BA, AL, SE), CW (MS), SE (MG, ES, SP, RJ), S (PR, SC, RS)
	P. ramosissima (Trin.) Soderstr. & Zuloaga**	NE (BA)
Piresia Swallen	*P. goeldii* Swallen	N (PA, AM, RR)
	P. leptophylla Soderstr.**	N (AM), NE (PB, PE, BA)
	P. macrophylla Soderstr.	N (AC, RO), NE (BA)
	P. apalmula Carvalho, Maria Luiza de & R. P. Oliveira**	NE (BA)
	P. sympodica (Döll) Swallen	N (PA, AM, AC), NE (PE, BA)
	P. tenella M.L.S.Carvalho & R.P.Oliveira	N (AM)
Raddia Bertol.	*R. angustifolia* Soderstr. & Zuloaga**	NE (CE, PE, BA)

Olyreae Genera	Olyreae Species	Distribution
	R. brasiliensis Bertol.**	NE (CE, PE, BA), CW (MS), SE (RJ)
	R. distichophylla (Schrad. ex Nees) Chase**	NE (BA)
	R. guianensis (Brongn.) Hitchc.	N (AP, PA), NE (RN, PE, BA, AL)
	R. lancifolia R. P. Oliveira & Longhi-Wagner**	SE (ES)
	R. megaphylla R. P. Oliveira & Longhi-Wagner**	NE (BA), SE (ES)
	R. portoi Kuhlm.**	NE (CE, PB, PE, BA, SE), SE (MG)
	R. soderstromii R. P. Oliveira, L. G. Clark & Judz.**	NE (RN, BA, SE), SE (MG, ES, RJ)
	R. stolonifera R. P. Oliveira & Longhi-Wagner**	NE (BA)
Raddiella Swallen	*R. esenbeckii* (Steud.) Calderón & Soderstr.	N (RR, PA, AM), NE (BA), CW (GO, DF), SE (MG, SP), S (PR)
	R. kaieteurana Soderstr.	N (PA)
	R. lunata Zuloaga & Judz.**	N (RO), CW (MT)
	R. malmeana (Ekman) Swallen**	N (PA), CW(MT)
	R. minima Judz. & Zuloaga**	N (PA)
Rehia Fitjen	*R. nervata* Fijten	N (PA), NE (MA)
Reitzia Swallen*	*R. smithii* Swallen**	SE (SP, RJ), S (SC)
Sucrea Soderstr.*	*S. maculata* Soderstr.**	NE (BA), SE (ES, RJ)
	S. monophylla Soderstr.**	NE (BA)
	S. sampaiana Soderstr.**	SE (ES, RJ)
Taquara I.L.C.Oliveira & R.P.Oliveira	*Taquara micrantha* (Kunth) I. L. C. Oliveira & R. P. Oliveira	NE (PI), CW (GO)

Sources: Adapted from (Filgueiras & Gonçalves, 2004; Greco et al., 2015; Jardim Botânico do Rio de Janeiro, 2023).

Notes: *: Endemic genus; **: Endemic species; South (S): States of Rio Grande do Sul (RS), Santa Catarina (SC) and Paraná (PR); Southeast (SE): States of São Paulo (SP), Rio de Janeiro (RJ), Minas Gerais (MG) and Espírito Santo (ES); Center-west (CW): States of Goiás (GO), Mato Grosso (MT), Mato Grosso do Sul (MS) and Federal District (DF); Northeast (NE): States of Bahia (BA), Sergipe (SE), Alagoas (AL), Pernambuco (PE), Paraíba (PB), Rio Grande do Norte (RN), Ceará, Piauí (PI) and Maranhão (MA); North (N): States of Acre (AC), Amazonas (AM), Rondônia (RO), Roraima (RR), Amapá (AP), Pará (PA) and Tocantins (TO).

Appendix 2. Tribe Bambuseae: Distribution of Genera and species per geographical region and state in Brazil.

Bambuseae Genera	Bambuseae Species	Distribution
Actinocladum McClure ex Soderstr.	*A. verticillatum* (Nees) McClure ex Soderstr.	CW (MT, GO, DF, MS), N (PA, AM), NE (BA), SE (MG, SP)
Alvimia C. E. Calderón ex Soderstr. & Londoño*	*A. auriculata* Soderstr. & Londoño**	NE (BA)
	A. gracilis Soderstr. & Londoño**	NE (BA)
	A. lancifolia Soderstr. & Londoño**	NE (BA)
Apoclada McClure*	*A. simplex* McClure & L. B. Sm.**	SE (SP), S (SC)
Arthrostylidium Rupr.	*A. fimbrinodum* Judz. & L. G. Clark**	N (AM, RO)
	A. grandifolium Judz. & L. G. Clark**	N (PA, AM, RO)
	A. scandens McClure	N (PA)
	A. simpliciusculum (Pilg.) McClure	N (AM)
Athroostachys Benth.*	*A. capitata* (Hook.) Benth.**	NE (BA)
	A. shepherdiana (Santos-Gonç., Filg. & L.G. Clark) Jesus-Costa & Santos-Gonç.**	SE (ES)
Atractantha McClure	*A. amazonica* Judz. & L. G. Clark	N (AM)
	A. aureolanata Judz.**	NE (BA)
	A. cardinalis Judz.**	NE (BA)
	A. falcata McClure**	NE (BA)
	A. radiata McClure**	NE (BA)
	A. shepherdiana Santos-Gonc., Filg. & L. G. Clark**	SE (ES)
Aulonemia Goudot	*A. amplissima* (Nees) McClure**	SE (MG, ES, SP, RJ), S (PR)
	A. aristulata (Döll) McClure**	NE (BA), CW (GO, DF), SE (MG, ES, SP, RJ), S (PR, SC)
	A. cincta P. L. Viana & Filg.**	S (PR)

Bambuseae Genera	Bambuseae Species	Distribution
	A. deflexa (N. E. Br.) McClure	N (RR)
	A. effusa (Hack.) McClure**	NE (BA), SE (MG)
	A. fimbriatifolia L. G. Clark **	SE (SP), S (PR, SC)
	A. glaziovii (Hack.) McClure**	SE (MG)
	A. goyazensis (Hack.) McClure**	SE (RJ)
	A. lanciflora McClure & L. B. Sm.**	SE (MG, RJ), S (SC, RS)
	A. prolifera P. L. Viana & Filg.**	SE (MG, ES)
	A. radiata (Rupr.) McClure & L. B. Sm.**	SE (MG, SP, RJ), S (PR, SC)
	A. ramosissima (Hack.) McClure**	SE (RJ)
	A. setigera (Hack.) McClure**	NE (BA), SE (RJ)
	Aulonemia setosa (Londoño & L. G. Clark) P. L. Viana & Filg.**	SE (RJ, SP, MG, ES)
	A. soderstromii P. L. Viana, Filg. & Judz.**	SE (ES, MG), NE (BA)
	A. xerophylla P. L. Viana & Filg.**	CW (GO, DF)
Bambusa Schreb.	*Bambusa bambos* (L.) Voss	SE (MG, SP)
	Bambusa beecheyana Munro	SE (SP)
	Bambusa blumeana Schult. & Schult.f.	SE (MG)
	Bambusa dissimulator McClure	SE (RJ, SP)
	Bambusa gracilis hort. ex Rivière & C. Rivière	NE (CE), SE (SP), S (PR)
	Bambusa longispiculata Gamble ex Brandis	SE (SP)
	Bambusa malingensis McClure	SE (SP)
	Bambusa multiplex (Lour.) Raeusch. ex Schult. & Schult.f.	SE (MG, RJ, SP), S (SC, RS)
	Bambusa mutabilis McClure	SE (SP)
	Bambusa nutans Wall. ex Munro	SE (SP)

Bambuseae Genera	Bambuseae Species	Distribution
	Bambusa oldhamii Munro	SE (RJ, SP), S (RS, SC)
	Bambusa remotiflora (Kuntze) L.C.Chia & H.L.Fung	SE (SP)
	Bambusa stenostachya Hack.	SE (SP)
	Bambusa textilis McClure	SE (SP), S (SC)
	Bambusa tulda Roxb.	SE (RJ, SP)
	Bambusa tuldoides Munro	CW (DF, GO), SE (ES, MG, RJ, SP), S (PR, RS, SC)
	Bambusa ventricosa McClure	SE (SP)
	Bambusa vulgaris Schrad. ex J.C.Wendl.	N (PA), NE (AL, BA, MA, PB, PE), CW (DF, GO, MS, MT), SE (ES, MG, RJ, SP), S (PR, RS, SC)
Cambajuva P. L. Viana, L. G. Clark & Filg.*	*C. ulei* (Hack.) P. L. Viana, L. G. Clark & Filg.**	S (SC, RS)
Chimonobambusa Makino	*Chimonobambusa quadrangularis* (Franceschi) Makino	SE (SP), S (SC)
Chusquea Kunth	*C. acuminata* Döll**	SE (RJ)
	C. anelythra Nees**	SE (MG, RJ), S (PR, SC)
	C. anelytroides Rupr. ex Döll**	SE (MG, SP, RJ), S (PR)
	C. attenuata (Döll) L. G. Clark**	SE (MG, SP)
	C. baculifera Silveira**	SE (MG)
	C. bahiana L. G. Clark**	SE (MG)
	C. bambusoides (Raddi) Hack.**	NE (BA), SE (ES, SP, RJ), S (PR, SC, RS)
	C. bradei L. G. Clark**	NE (BA), SE (ES)
	C. caparaoensis L. G. Clark**	SE (MG)
	C. capitata Nees**	SE (MG, ES, SP, RJ), S (PR, SC)
	C. capituliflora Trin.**	SE (MG, SP, RJ), S (PR, SC, RS)

Bambuseae Genera	Bambuseae Species	Distribution
	C. capituliflora var. *pubescens* McClure & L. B. Sm.**	SE (MG, SP, RJ), S (PR, SC, RS)
	C. ciliatifolia A. C. Mota, R. P. Oliveira & L. G. Clark**	SE (MG), NE (BA)
	C. clemirae A. C. Mota, R. P. Oliveira & L. G. Clark**	NE (BA)
	C. diversiglumis (Soderstr.) L. G. Clark	N (AM)
	C. erecta L. G. Clark**	SE (SP)
	C. fasciculata Döll**	SE (MG)
	Chusquea fruticosa Pianiss., Santos-Gonç. & L.G. Clark**	SE (MG, RJ)
	Chusquea gouveiensis K. Vidal & L. G. Clark**	SE (MG)
	C. gracilis McClure & L. B. Sm.**	S (PR, SC, RS)
	C. hatschbachii L. G. Clark**	S (SC)
	C. heterophylla Nees**	SE (MG, SP, RJ)
	C. ibiramae McClure & L. B. Sm.**	SE (ES, SP), S (PR, SC)
	Chusquea imbricata Pianiss., L.G. Clark & Santos-Gonç.**	SE (MG)
	C. juergensii Hack.	SE (MG, SP), S (PR, SC, RS)
	Chusquea kleinii A. C. Mota, R. P. Oliveira & L. G. Clark**	SE (RJ, SP), S (PR, RS, SC)
	C. leptophylla Nees**	SE (MG, ES, SP, RJ), S (PR, SC, RS)
	C. linearis N. E. Br.**	N (RR)
	C. longispiculata L. G. Clark**	SE (SP, RJ)
	C. magnifolia L. G. Clark**	N (AM)
	C. meyeriana Rupr. ex Döll**	SE (MG, SP, RJ), S (PR, SC, RS)

Bambuseae Genera	Bambuseae Species	Distribution
	Chusquea microphylla (Döll) L. G. Clark**	SE (MG, RJ)
	C. mimosa McClure & L. B. Sm.**	S (PR, SC, RS)
	C. mimosa subsp. *australis* L. G. Clark**	S (PR, SC, RS)
	C. mirabilis A. C. Mota, (Viana & Filgueiras, 2014)rk**	SE (MG), NE (BA)
	C. nudiramea L. G. Clark**	S (SC)
	C. nutans L. G. Clark**	NE (BA), SE (MG)
	C. oligophylla Rupr.**	SE (SP, RJ), S (PR, SC)
	C. oxylepis (Hack.) Ekman**	NE (BA), SE (MG, SP, RJ), S (PR, SC)
	Chusquea parviligulata R. S. Andrade, Pianiss. & L. G. Clark**	NE (BA)
	C. pinifolia (Nees) Nees**	SE (MG, SP, RJ)
	C. pulchella L. G. Clark**	SE (SP, RJ)
	C. ramosissima Lindm.	NE (BA), SE (ES, SP, RJ), S (PR, SC, RS)
	C. riosaltensis L. G. Clark**	SE (MG)
	C. sclerophylla Döll**	SE (RJ)
	C. sellowii Rupr.**	SE (MG, SP, RJ), S (PR, SC, RS)
	C. tenella Nees**	SE (MG, SP), S (PR, SC, RS)
	C. tenuiglumis Döll**	SE (MG, SP), S (SC)
	Chusquea tenuiglumis Döll var. tenuiglumis**	SE (MG, RJ, SP), S (SC)
	C. tenuiglumis var. *laxiuscula* Döll**	SE (MG)
	C. tenuiglumis var. *subcylindrica* Döll**	SE (MG)
	C. tenuis Glaz. ex E. G. Camus**	SE (RJ)

Bambuseae Genera	Bambuseae Species	Distribution
	C. urelytra Hack.**	SE (ES, SP, RJ), S (PR)
	C. wilkesii Munro**	SE (MG)
	C. windischii L. G. Clark**	S (SC)
Colanthelia McClure & L. B. Sm.	*C. burchellii* (Munro) McClure**	SE (SP, RJ)
	C. cingulata (McClure & L. B. Sm.) McClure**	SE (SP, RJ), S (SC, RS)
	C. distans (Trin.) McClure**	SE (MG)
	C. intermedia (McClure & L. B. Sm.) McClure**	SE (RJ), S (SC, RS)
	Colanthelia kinoshitae Santos-Gonç., Filg. & L.G.Clark**	SE (RJ)
	Colanthelia longipetiolata Jesus-Costa & Santos-Gonç.**	SE (MG)
	C. macrostachya (Nees) McClure	SE (SP, RJ)
	C. rhizantha (Hack.) McClure	S (PR, RS)
	Colanthelia secundiflora Santos-Gonç., Filg. & L.G.Clark**	SE (SP)
	Colanthelia sparsiflora Santos-Gonç., Filg. & L.G.Clark**	SE (ES)
Dendrocalamopsis (L.C.Chia & H.L.Fung) Keng f.	*Dendrocalamopsis beechiana* (Munro) Keng f.	SE (SP)
Dendrocalamus Nees	*Dendrocalamus asper* (Schult. & Schult.f.) Baker ex K.Heyne	NE (BA), CW (DF, GO, MT), SE (ES, MG, RJ, SP), S (PR, SC)
	Dendrocalamus brandisii (Munro) Kurz	SE (SP)
	Dendrocalamus giganteus Wall. ex Munro	NE (MA, PE), CW (DF), SE (MG, RJ, SP), S (PR, RS, SC)
	Dendrocalamus latiflorus Munro	SE (SP)

Bambuseae Genera	Bambuseae Species	Distribution
	Dendrocalamus macroculmis (Rivière) J.Houz.	SE (SP)
	Dendrocalamus strictus (Roxb.) Nees	SE (SP)
Drepanostachyum Keng f.	*Drepanostachyum falcatum* (Nees) Keng f.	CW (DF, GO), SE (ES, MG, RJ, SP), S (RS, SC)
Eremocaulon Soderstr. & Londoño	*E. amazonicum* Londoño**	N (AC, AM, RO)
	E. asymmetricum (Soderstr. & Londoño) Londoño**	NE (BA)
	E. aureofimbriatum Soderstr. & Londoño**	NE (BA), SE (MG)
	E. capitatum (Trin.) Londoño	CW (MT)
	Eremocaulon triramis C. Jesus-Costa & Londoño**	SE (ES)
Filgueirasia Guala*	*Filgueirasia arenicola* (McClure) Guala**	NE (BA), CW (MT, GO, MS), SE (MG)
	F. cannavieira (Silveira) Guala**	CW (GO, DF), SE (MG)
Gigantochloa Kurz ex Munro	*Gigantochloa apus* (Schult. & Schult.f.) Kurz	SE (SP)
	Gigantochloa verticillata (Willd.) Munro	SE (SP)
Glaziophyton Franch.*	*G. mirabile* Franch.**	SE (RJ)
Guadua Kunth	*Guadua amplexifolia* J.Presl.	SE (SP)
	Guadua angustifolia Kunth	NE (AL), CW (MS), SE (RJ, SP), S (PR, RS, SC)
	G. calderoniana Londoño & Judz.**	NE (BA)
	G. chacoensis (Rojas) Londoño & P. M. Peterson	CW (MS), S (PR, RS)
	G. ciliata Londoño & Davidse	N (PA, AM)
	G. glomerata Munro	N (PA, AM)
	G. latifolia (Bonpl.) Kunth	N (AM)

Bambuseae Genera	Bambuseae Species	Distribution
	G. macrospiculata Londoño & L. G. Clark	N (AM)
	G. macrostachya Rupr.	N (AM)
	G. maculosa (Hack.) E. G. Camus**	N (AM)
	G. magna Londoño & Filg.**	CW (GO)
	G. paniculata Munro	CW (MS, GO, DF), SE (MG, SP), S (RS)
	G. paraguayana Döll	SE (SP), S (PR)
	G. refracta Munro**	CW (GO, DF), SE (MG)
	G. sarcocarpa Londoño & P. M. Peterson	N (AC)
	G. superba Huber	N (AC, AM)
	G. tagoara (Nees) Kunth	Include CW (GO), NE (Exclude MA, BA), SE (MG, ES, SP, RJ), S (PR, SC, RS)
	G. tagoara subsp. *glaziovii* (Hack.) Londoño & L. G. Clark**	SE (RJ)
	G. trinii (Nees) Nees ex Rupr.	SE (MG), S (SC, RS)
	Guadua velutina Londoño & L. G. Clark	SE (SP)
	G. virgata (Trin.) Rupr.**	CW (GO)
	G. weberbaueri Pilg.	N (AC)
Himalayacalamus Keng f.	*Himalayacalamus falconeri* (Munro) Keng f.	SE (SP), S (SC)
Melocanna Trin.	*Melocanna baccifera* (Roxb.) Kurz	SE (SP)
Merostachys Spreng.	*M. abadiana* Send.**	SE (SP)
	M. annulifera Send.**	NE (BA)
	M. argentea Send.**	NE (BA)
	M. argyronema Lindm.**	SE (SP)
	M. bifurcata Send.**	SE (SP)

Bambuseae Genera	Bambuseae Species	Distribution
	M. brevigluma Send.**	SE (MG, SP)
	M. burmanii Send.**	NE (BA), SE (SP, RJ)
	Merostachys cachimboensis Lopes-Neto & P.L.Viana**	N (PA), CW (MT)
	M. calderoniana Send.**	NE (BA)
	M. caucaiana Send.**	SE (SP), S (RS)
	Merostachys ciliata McClure & L. B. Sm.**	S (PR, SC)
	M. clausenii Munro	CW (GO), SE (MG), S (PR, RS)
	Merostachys delicatula R. S. Andrade, Pianiss., Viníc.-Silva & R.P. Oliveira**	NE (BA)
	Merostachys espessa R. Vinícius-Silva, L. G. Clark & Santos-Gonçalves**	SE (MG)
	M. exserta Munro**	SE (MG)
	M. filgueirasii Send.**	CW (DF)
	M. fimbriata Send.**	N (RO)
	Merostachys fimbriolaminata R. Vinícius-Silva, Cupertino- Eisenlohr & Santos-Gonçalves	SE (MG)
	M. fischeriana Rupr. ex Döll**	NE (BA), SE (MG, RJ), S (PR)
	M. fistulosa Döll**	SE (MG, SP), S (PR)
	M. glauca McClure & L. B. Sm.**	S (SC)
	Merostachys judziewiczii Viníc.-Silva, L.G.Clark & Santos-Gonç.**	SE (MG)
	M. kleinii Send.**	S (SC)
	M. kunthii Rupr.**	SE (RJ)
	M. lanata Send.**	NE (BA)

Bambuseae Genera	Bambuseae Species	Distribution
	M. leptophylla Send.**	NE (BA), SE (SP)
	M. magellanica Send.**	SE (SP, RJ)
	M. magnispicula Send.**	NE (BA)
	M. medullosa Send.**	NE (BA)
	M. multiramea Hack.	NE (BA), CW (GO), SE (SP, RJ), S (PR, SC, RS)
	M. neesii Rupr.**	NE (BA), SE (SP, RJ)
	M. petiolata Döll**	NE (BA), SE (MG, SP, RJ)
	M. pilifera Send.**	S (RS)
	M. pluriflora Munro ex E. G. Camus**	SE (SP, RJ), S (SC)
	M. polyantha McClure**	SE (SP)
	M. procerrima Send.**	NE (BA), SE (ES)
	Merostachys ramosa E.M. Pianissola, Vinícius-Silva & L.G. Clark**	SE (MG)
	M. ramosissima Send.**	NE (BA)
	M. riedeliana Rupr. ex Döll**	SE (MG, SP)
	M. rondoniensis Send.**	N (RO)
	M. scandens Send.**	SE (SP)
	M. sellovii Munro**	NE (BA)
	M. skvortzovii Send.**	SE (SP), S (PR, SC, RS)
	Merostachys soderstromii Viníc.-Silva, L.G.Clark & Santos-Gonç.	NE (BA), SE (ES)
	M. sparsiflora Rupr.**	NE (BA)
	M. speciosa Spreng.**	SE (MG, SP), S (PR, SC, RS)
	M. tatianae Santos-Gonçalves, Carvalho-Okano & Filg.**	SE (MG)
	M. ternata Nees**	NE (BA), SE (MG, SP, RJ), S (PR, SC, RS)
	M. vestita McClure & L. B. Sm.**	S (SC)

Bambuseae Genera	Bambuseae Species	Distribution
	Merostachys ximenae D.F. Parma, R. Vinícius-Silva & A.P. Santos-Gonçalves**	SE (MG)
Myriocladus Swallen	*Myriocladus caburaiensis* Afonso & P.L. Viana	N (RR)
	M. grandifolius Swallen	N (AM)
	M. neblinaensis Swallen	N (AM)
	M. paludicolus Swallen	N (AM)
	M. virgatus Swallen	N (AM)
Ochlandra Thwaites	*Ochlandra travancorica* (Bedd.) Benth. ex Gamble	SE (SP)
Phyllostachys Siebold & Zucc.	*Phyllostachys aurea* Carrière ex Rivière & C. Rivière	CW (DF, GO, MS), SE (MG, RJ, SP), S (PR, RS, SC)
	Phyllostachys bambusoides Siebold & Zucc.	CW (DF, GO), SE (ES, MG, RJ), S (RS, SC)
	Phyllostachys edulis (Carrière) J.Houz.	SE (SP)
	Phyllostachys nigra (Lodd. ex Lindl.) Munro	SE (RJ, SP), S (PR, RS)
	Phyllostachys viridiglaucescens (Carrière) Rivière & C.Rivière	SE (SP)
Pleioblastus Nakai	*Pleioblastus argenteostriatus* (Regel) Nakai	S (SC)
	Pleioblastus simonii (Carrière) Nakai	SE (MG, SP), S (SC)
Pseudosasa Makino ex Nakai	*Pseudosasa japonica* (Siebold & Zucc. ex Steud.) Makino ex Nakai	SE (SP)
Rhipidocladum McClure	*R. parviflorum* (Trin.) McClure	N (PA, RR), CW (GO, DF), SE (MG, RJ, SP), S (PR)
	R. racemiflorum (Steud.) McClure	SE (RJ)
Sasa Makino & Shibata	*Sasa fortunei* (Van Houtte) Fiori	SE (SP)

Bambuseae Genera	Bambuseae Species	Distribution
Shibataea Makino ex Nakai	*Shibataea kumasaka* (Zoll. ex Steud.) Makino	SE (SP)
Taquara I.L.C.Oliveira & R.P.Oliveira	*Taquara micrantha* (Kunth) I.L.C.Oliveira & R.P.Oliveira	N (AC, AM, AP, PA, RO, RR, TO), NE (AL, BA, CE, MA, PB, PE, RN, SE), CW (DF, MS, MT), SE (ES, MG, RJ, SP), S (PR, RS, SC)
Thyrsostachys Gamble	*Thyrsostachys siamensis* Gamble	SE (SP)

Sources: Adapted from (Filgueiras & Gonçalves, 2004; Greco et al., 2015; Jardim Botânico do Rio de Janeiro, 2023)

Notes: *: Endemic genus; **: Endemic species; South (S): States of Rio Grande do Sul (RS), Santa Catarina (SC) and Paraná (PR); Southeast (SE): States of São Paulo (SP), Rio de Janeiro (RJ), Minas Gerais (MG) and Espírito Santo (ES); Center-west (CW): States of Goiás (GO), Mato Grosso (MT), Mato Grosso do Sul (MS) and Federal District (DF); Northeast (NE): States of Bahia (BA), Sergipe (SE), Alagoas (AL), Pernambuco (PE), Paraíba (PB), Rio Grande do Norte (RN), Ceará, Piauí (PI) and Maranhão (MA); North (N): States of Acre (AC), Amazonas (AM), Rondônia (RO), Roraima (RR), Amapá (AP), Pará (PA) and Tocantins (TO).

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