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EUCALYPTUS FORESTRY IN BAHIA: SPATIAL DISTRIBUTION, PRODUCTION SEGMENTS, AND CHALLENGES FOR SUSTAINABLE EXPANSION

SILVICULTURA DE EUCALIPTO NA BAHIA: DISTRIBUIÇÃO ESPACIAL, SEGMENTOS DA PRODUÇÃO E DESAFIOS PARA A EXPANSÃO SUSTENTÁVEL

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RESUMO

A silvicultura de *Eucalyptus* L' Heritier na Bahia é destaque nacional, em termos de produtividade, alto nível tecnológico, infraestrutura e de promoção de condições sociais nas comunidades rurais, além da grande responsabilidade ambiental com que a atividade é exercida. O objetivo deste estudo é caracterizar a distribuição do setor florestal de espécies do gênero *Eucalyptus* L'Heritier, por área plantada e por segmento de produção madeireira, a fim de compreender o comportamento do setor nas mesorregiões do estado da Bahia. Foram determinadas as áreas de produção na Bahia para os segmentos de carvão vegetal, lenha, papel e celulose e outras finalidades referente ao ano de 2022, distribuídas entre as mesorregiões: Extremo Oeste da Bahia (EOB), Centro Norte da Bahia (CNB), Nordeste da Bahia (NB), metropolitana de Salvador (MS), Centro Sul da Bahia (CSB), Sul da Bahia (SB) e Vale do São Francisco (VSF). Esses dados foram obtidos do Instituto Brasileiro de Geografia e Estatística (IBGE) e do World Resources Institute–Global Forest Watch (WRI/GFW). Os dados foram submetidos a estatística descritiva e interpolação pelo método IDW (Inverse Distance Weighted), utilizando o QGIS® 3.32.2. O estudo revelou um desequilíbrio na distribuição de plantações florestais e produção madeireira por segmentos especializados entre as mesorregiões da Bahia. Diante da situação atual, a promoção do cultivo de eucalipto nas regiões menos favorecidas, principalmente em pequenas propriedades rurais na região semiárida da Bahia, surge como uma alternativa significativa para reduzir a desvantagem. Essa abordagem tem o potencial de produzir madeira de maior valor para consumo local, contribuindo assim para a redução da exploração madeireira em florestas nativas.

PALAVRAS-CHAVE: **Lenha, floresta plantada, silvicultura, segmentos madeireiros.**

ABSTRACT

Eucalyptus L' Heritier forestry activity in Bahia stands out nationwide for its productivity, advanced technological level, infrastructure, and promotion of social conditions in rural communities. The activity is carried out with a strong commitment to the environment, resulting in significant socioeconomic benefits for the rural communities involved. the objective of this study is to characterize the distribution of the forestry sector of species of the genus *Eucalyptus* L'Heritier, by planted area and by segment of wood production, in order to understand the behavior of the sector in the mesoregions the state of Bahia. The production areas in Bahia were determined for the charcoal, firewood, paper and cellulose segments and other purposes in 2022, distributed among the mesoregions: Extreme West of Bahia (EWB), Central North of Bahia (CNB), Northeast of Bahia (NB), Metropolitan of Salvador (MS), Central South of Bahia (CSB), South of Bahia (SB) and Valley of São Francisco (VSF). These data were obtained from the Brazilian Institute of Geography and Statistics (IBGE) and the World Resources Institute–Global Forest Watch (WRI/GFW). The data were subjected to descriptive statistics and IDW (Inverse Distance Weighted) interpolation method, using QGIS® 3.32.2. The study revealed an imbalance in the distribution of forest plantations and wood production by specialized segments among the mesoregions of Bahia. Given the current situation, promotion of eucalyptus cultivation in the less favored regions, mainly on small rural properties in the semi-arid region of Bahia, as a significant alternative to reduce disadvantage. This approach has the potential to produce higher-value wood for local consumption, thereby contributing to the reduction of logging in native forests.

KEYWORDS: **Firewood, planted forest, silviculture, wood segments.**

INTRODUCTION

The Brazilian forestry sector, especially planted forests of the genus *Eucalyptus* L'Héritier, has reached an excellent technological level since 1960, with advances in silviculture, conservation, planning, development, logistics and processing, technology and genetics, making Brazil influential in forest management (NUNES et al., 2002; XAVIER & SILVA, 2010; VALE et al., 2014; SCHUMACHER & VIERA, 2015; INOUE, 2020; RODRIGUES et al., 2021).

These advances have contributed to a steady increase in wood productivity, optimization of production sites, restoration of degraded areas, and improved profitability. Intensive eucalyptus forestry, a renewable resource, is carried out with environmentally friendly techniques, generating increasingly qualified and certified products according to protocol guidelines and relevant legislation (HOSOKAWA et al., 2013; FLOR, 2014; HIGMAN et al., 2015; SCHUMACHER & VIERA, 2015).

Wood production has justified the expansion of forestry activities in Brazil, mainly because the sector has faced problems related to the supply and demand of wood (STAPE et al., 2010). This production covers a large part of the wood demand from different economic sectors, such as mining (especially for energy production and support structures in mineral extraction activities), civil construction, the steel industry, and the pulp and paper industry, for example (RODRIGUES et al., 2021).

Eucalyptus wood production forestry is diversified due to its various specialized uses, with wood pulp production standing out because of its high international demand. In 2019, Brazil accounted for 24% of the 55,028,834 tons traded in the global export market (KLEIN & LUNA, 2022). Of the more than 9.4 million ha of planted forests in Brazil, just over 77% are eucalyptus plantations. The Northeast region accounts for 12% of the planted area in Brazil, with Bahia alone representing 64% of that regional total (GAMA et al., 2025).

Bahia is one of the largest producers of wood in the Northeast region, accounting for 78.27% of firewood and 59.64% of pulp and paper produced in this region (GAMA et al., 2025). In 2018, at the national level, the State of Bahia ranked third in pulp and paper production with 13,763,068 m³, behind Mato Grosso do Sul (17,511,680 m³) and São Paulo with 13,965,687 m³ (RODRIGUES et al., 2021), demonstrating its national prominence in the sector**.**

However, this prominence of the State of Bahia in the forestry sector practically began in 1980 and was consolidated, especially with the installations of Suzano and Aracruz (RODRIGUES et al., 2021), which allowed a greater improvement of its expertise in the production of cellulose, soluble cellulose, paper, iron alloys, treated wood, charcoal and firewood (ABAF, 2023). This trend intensified after 2010 through the actions of the main reforestation agents (integrated steel industry and cellulose sector on a global scale), although the expansion of areas has stabilized in recent years in the state (RODRIGUES et al., 2021; ABAF, 2023).

Some actions have been proposed to promote eucalyptus forestry in the state. One such action is the 'Mais Árvores Bahia' Program, an initiative of the Association of Forest-Based Companies of the State of Bahia (ABAF, 2022). The program's strategic approach entails the decentralization of the local economy, fostering the creation of more specialized employment opportunities and generating substantial income while concurrently promoting significant social and environmental contributions in inland municipalities. Additionally, it aims to reconcile various agricultural activities with the silvicultural cycle, ensuring that both parties involved benefit from this collaboration (ABAF, 2022).

By 2022, the forestry sector in Bahia had 500 companies occupying an area of one million hectares, with 618 thousand hectares of production (1% of the state's area) and another 310 thousand hectares of native and protected forest areas (ABAF, 2022).

Although the forestry sector has developed in the State of Bahia, it has had a disproportionate impact on economically sensitive regions, such as the semi-arid region of Bahia.

However, land occupation in the semi-arid region has been predominantly by pastures for cattle production, which occupy more than 40% of the area of rural properties in the semi-arid region, representing more than 70% of some areas, such as in the Itapetinga Microregion, in the State of Bahia (SANTOS et al., 2011). Despite the prevalence of shallow and stony soils, which impose limitations on cultivation in semi-arid regions (RODRIGUES et al., 2021), a substantial portion of the territory is characterized by the presence of deep soils and relatively flat topography, which are conducive to the implementation of eucalyptus forestry (GAMA & JESUS, 2020). This region is characterized by a substantial presence of degraded areas and abandoned or underutilized grasslands (CASTRO & MAIA, 2021; CUNHA et al., 2021; SOUZA et al., 2021; GAMA et al., 2022; OLIVEIRA et al., 2023; NOGUEIRA et al., 2024). Therefore, the recovery of these areas through eucalyptus

plantations is an economic alternative and a potential solution to the region's social problems.

According to Gomes et al. (2006), when implemented by forestry companies, forestry projects have the potential to strengthen both the economic and social structures of communities, thereby creating a more stable environment for the sector in which they conduct their business. Consequently, these initiatives can serve as a model for municipal public policies aimed at fostering the formation of eucalyptus forests as an economic alternative for small rural properties.

As stated by Alves et al. (2011), reforestation using eucalyptus species is a pivotal strategy for the long-term establishment of a consistent supply of firewood, particularly due to their rapid growth rate, which makes them a significant component of public policies on renewable energy. The imperative for the renewal of the national energy matrix has prompted the initiation of new research due to the pressing need to promote environmentally sustainable energy sources (MIRANDA et al., 2019). In terms of energy resources in Brazil, forests represent 20% of this available potential, yet only 8.1% of the renewable energy used in Brazil is supplied by firewood biomass and charcoal (MIRANDA et al., 2019).

Despite the presence of distorted public policies, such as high taxes and fees and market fluctuations, eucalyptus forestry in Brazil manages to be profitable and competitive, as posited by Soares et al. (2010).

Regarding charcoal production, specifically, Bichel & Telles (2021) assert that forestry-based production exhibits greater competitiveness compared to extractivism, primarily due to the relatively low cost of specialization in forestry. This phenomenon signifies an economic opportunity for small properties, particularly in the production of charcoal and firewood.

In this context, this study aims to characterize the distribution of eucalyptus plantations in Bahia by planted area and wood production segment, in order to understand the spatial dynamics of the sector across the state's mesoregions.

MATERIAL AND METHODS

Characterization of the area

The study was carried out in the State of Bahia, covering an area of 564,760.429 km² located in the Northeast region of Brazil (BRASIL, 2022a). It brings together 417 municipalities distributed in seven mesoregions: Extreme West of Bahia (24 municipalities), Valley of São Francisco (27), Central North of Bahia (80), Northeast of Bahia (60), Metropolitan of Salvador (38), Central South of Bahia (118) and South of Bahia (70) (BRASIL, 2022a) (Figure 1).

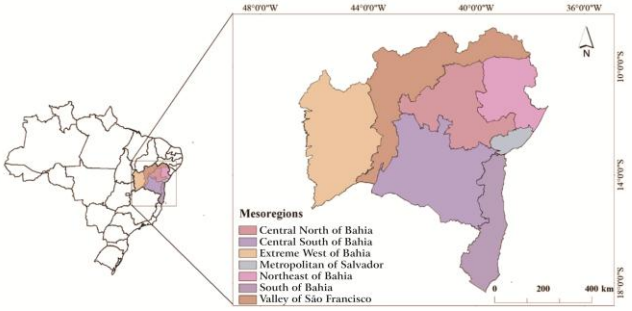

Figure 1. Distribution of mesoregions in the State of Bahia, 2023. Based on data at a scale of 1:250,000 and according to the Brazilian Geodetic System DATUM Sirgas 2000 (BRASIL, 2022b).

The natural vegetation that covers Bahia is characterized by different types of formations, including seasonal deciduous, semi-deciduous, and rainforests, as well as associated ecosystems. These formations are characteristic of the Atlantic Forest Biome and areas of ecotones with the Caatinga. Additional formations include seasonal semi-deciduous and seasonally dry forests, stretches of open and mountainous areas in the Caatinga Biome, the Cerrado Biome, and areas of ecotones between these two. Of these biomes within the State of Bahia, the Caatinga biome is particularly noteworthy for its extensive coverage, encompassing 53% of the state's total area. It is predominantly present in the mesoregions of the Northeast, Central South, Valley of São Francisco, and Central North of Bahia (BRITO et al., 2005; COUTINHO, 2006; 2016; BRASIL, 2019).

The climate of Bahia is distributed across three distinct zones: the Hot Dry Tropical, which occurs in the mesoregions of the Extreme West and part of the Central South, Valley of São Francisco and Metropolitan of Salvador; the Hot and Humid Tropical Atlantic, formed over the South Mesoregion and part of the Central South and Metropolitan of Salvador; and the Semiarid climate zone in the Northeast region, Central North, part of the Central South and the mesoregion of the Valley of São Francisco (SIMÕES et al., 2018).

These climate zones account for mean annual temperatures ranging from low (between 20 °C and 24 °C) and high (between 24 °C and 28 °C), resulting in an average rainfall regime of 241–2,049 mm year^{-1}, with heavy rainfall occurring from November to February,

characterized as summer rainfall events in much of the state (SIMÕES et al., 2018; PIRES et al., 2023).

Data collection and analysis

Through the electronic platform of the Brazilian Institute of Geography and Statistics (IBGE), using data from the Production of Plant Extraction and Silviculture database (BRASIL, 2023), it was possible to obtain data on eucalyptus forestry in the State of Bahia for the year 2022, including wood production in the segments of pulp and paper, firewood, charcoal, and other purposes (logs for civil construction, stakes, fence posts, etc.), broken down by the geographic mesoregions of the State of Bahia: Extreme West of Bahia, Central North of Bahia, Northeast of Bahia, Metropolitan of Salvador, Central South of Bahia, South of Bahia, and Valley of São Francisco.

The number of municipalities with eucalyptus plantations and the size of plantation areas within these municipalities, distributed according to their respective geographic mesoregions, were also surveyed**.** These data were subjected to the area-to-number ratio ($A.N^{-1}$) in order to estimate the degree of polarization in the expansion of eucalyptus forestry activity within each mesoregion.

The vector cartographic bases (SHP format) of eucalyptus planted forest areas distributed throughout Bahia were obtained from the database available on the World Resources Institute–Global Forest Watch platform (WRI/GFW, 2022). The territorial boundaries (SHP) of Bahia and its geographic mesoregions were obtained from the database available at the Brazilian Institute of Geography and Statistics (IBGE) (BRASIL, 2022b).

The spatial representation of eucalyptus planted areas distributed across the mesoregions of Bahia (raster surface) was generated using the IDW (Inverse Distance Weighted) interpolation method, assigning color gradients according to the proximity and density of the estimated values derived from the vector cartographic datasets (SHP) of planted areas and geographic boundaries.

The existing eucalyptus plantation areas were grouped into five density classes and differentiated according to the size intervals to which each area unit belonged, ranging from the minimum class (230 to 1,500 ha) to the maximum class (58,000 to 340,000 ha)**.** The size class corresponding to areas smaller than 220 hectares (0 to 220 ha) was considered a low-density planting class because these areas could not be properly represented on the thematic map due to spatial scale limitations**.**

Cartographic data (SHP) were processed using QGIS software version 3.32.2®.

RESULTS AND DISCUSSION

Participation of mesoregions with eucalyptus plantations in Bahia

Eucalyptus forestry in the State of Bahia covers a total area of 564,456 ha of planted forests, equivalent to only 1.01% of the state's territory. The planted areas were distributed across 110 municipalities, corresponding to 26.4% of the total number of municipalities in Bahia.

With the exception of the Valley of São Francisco, which is the only mesoregion where eucalyptus plantations do not occur, the South of Bahia represents the mesoregion with the largest area planted with eucalyptus (71.25%), followed by the Northeast of Bahia (16.60%) and the Extreme West of Bahia (5.38%).

In terms of the number of municipalities per mesoregion, the South of Bahia has the largest number of participating municipalities (30.0%), followed by the Central South of Bahia (27.27%). Regarding the area-to-municipality ratio**,** the Central North mesoregion presented the lowest plantation density, whereas the highest values were observed in the South of Bahia, followed by the Northeast of Bahia (Table 1).

Table 1. Distribution of areas cultivated with eucalyptus by areas of the mesoregions of the State of Bahia, Brazil, with the respective number of municipalities.

Mesoregion	Area in hectares		Number of municipalities		A.N^{-1} (ha)
Extreme West of Bahia	30,364.00	(5.38%)	12	(10.91%)	2,530.00
Central North of Bahia	599.00	(0.11%)	5	(4.55%)	120.00
Northeast of Bahia	93,829.00	(16.60%)	18	(16.36%)	5,213.00
Metropolitan of Salvador	16,437.00	(2.91%)	12	(10.91%)	1,370.00
Central South of Bahia	21,060.00	(3.73%)	30	(27.27%)	702.00
South of Bahia	402,167.00	(71.25%)	33	(30.00%)	12,187.00
Valley of São Francisco	-	-	-	-	-
Total	**564,456.00**	**(100%)**	**110**	**100%**	**5,131.00**

ha = area unit in hectare; A.N^{-1} = Area / Number (mean value of the ratio of the planted forest area to the number of participating municipalities). Source: IBGE (2023).

Municipalities and areas with eucalyptus plantations by mesoregions in Bahia

In the South of Bahia mesoregion, 59.8% (240,313.00 ha) of the eucalyptus plantations were concentrated in four municipalities (Table 2). Plantations smaller than 200 ha accounted for 37.7% of the total and were predominantly located in municipalities of the Central South mesoregion. The South of Bahia accounted for 26.6% of these smaller plantations, while the Metropolitan of Salvador represented 11.1% (Table 2).

Table 2. Distribution of eucalyptus planted areas by municipality in the State of Bahia, Brazil.

Municipalities	MB	Area (ha)	Municipalities	MB	Area (ha)
Caravelas	SB	79,449.00	Pojuca	MS	537.00
Mucuri	SB	58,158.00	Tremedal	CSB	500.00
Nova Viçosa	SB	57,043.00	Nova Soure	NB	410.00
Alcobaça	SB	45,663.00	Ribeirão do Largo	CSB	390.00
Entre Rios	NB	22,245.00	Crisópolis	NB	318.00
Santa Cruz Cabrália	SB	21,865.00	Seabra	CSB	310.00
Eunápolis	SB	19,620.00	Condeúba	CSB	300.00
Belmonte	SB	18,772.00	Olindina	NB	292.00
Porto Seguro	SB	16,993.00	Ouriçangas	CNB	254.00
Itagimirim	SB	13,990.00	Camaçari	MS	236.00
Inhambupe	NB	12,559.00	Itapicuru	NB	200.00
Teixeira de Freitas	SB	11,726.00	Barra do Choça	CSB	200.00
Esplanada	NB	11,348.00	Jucuruçu	SB	200.00
Aramari	NB	11,038.00	Água Fria	CNB	169.00
Prado	SB	10,701.00	Jaguaquara	CSB	160.00
Ibirapuã	SB	10,000.00	Maragogipe	MS	153.00
Alagoinhas	NB	9,555.00	Formosa do Rio Preto	EWB	150.00
Catolândia	EWB	8,500.00	Piripá	CSB	150.00
Itanagra	MS	7,463.00	Feira de Santana	NB	134.00
Guaratinga	SB	6,518.00	Ubaíra	CSB	130.00
Mascote	SB	6,407.00	Luís Eduardo Magalhães	EWB	120.00
Araçás	NB	6,236.00	Cristópolis	EWB	120.00
Conde	NB	5,872.00	Ipiaú	SB	120.00
Itabela	SB	5,609.00	Itanhém	SB	112.00
São Desidério	EWB	5,600.00	Presidente Tancredo Neves	SB	100.00
Jaborandi	EWB	5,000.00	Itagibá	SB	100.00
Cardeal da Silva	NB	4,984.00	Jaguaripe	MS	94.00
Mata de São João	MS	4,858.00	Dias d'Ávila	MS	93.00
Jandaíra	NB	4,308.00	Iraquara	CNB	80.00
Lajedão	SB	4,028.00	Ibicoara	CSB	80.00
Baianópolis	EWB	4,000.00	Igrapiúna	SB	80.00
Vitória da Conquista	CSB	3,700.00	Cotegipe	EWB	74.00
Vereda	SB	3,404.00	Cachoeira	MS	74.00
Encruzilhada	CSB	3,400.00	Barra da Estiva	CSB	65.00
Medeiros Neto	SB	3,371.00	Jequié	CSB	60.00
Itapebi	SB	3,331.00	Souto Soares	CNB	53.00

Valença	SB	3,200.00	Jiquiriçá	CSB	50.00
Rio Real	NB	2,743.00	Laje	CSB	50.00
Maracás	CSB	2,527.00	São Miguel das Matas	CSB	50.00
Planaltino	CSB	2,518.00	Dário Meira	CSB	50.00
Barreiras	EWB	2,400.00	Poções	CSB	50.00
Correntina	EWB	2,000.00	Barra do Rocha	SB	50.00
Riachão das Neves	EWB	1,800.00	São Gonçalo dos Campos	CNB	43.00
Lençóis	CSB	1,755.00	São Francisco do Conde	MS	41.00
Belo Campo	CSB	1,500.00	Ibirataia	SB	40.00
Santo Amaro	MS	1,429.00	Teolândia	SB	40.00
Canavieiras	SB	1,422.00	Wenceslau Guimarães	SB	40.00
Cândido Sales	CSB	1,400.00	Palmeiras	CSB	37.00
Acajutiba	NB	1,009.00	Biritinga	NB	30.00
Mucugê	CSB	912.00	Irajuba	CSB	20.00
Catu	MS	781.00	Itiruçu	CSB	20.00
São Sebastião do Passé	MS	678.00	Candiba	CSB	20.00
Potiraguá	CSB	645.00	Lajedo do Tabocal	CSB	11.00
Santa Rita de Cássia	EWB	600.00	Camamu	SB	10.00
Aporá	NB	548.00	Santa Luzia	SB	5.00

ha = area unit in hectare; MB = Mesoregions of Bahia; EWB = Extreme West of Bahia; CNB = Central North of Bahia; NB = Northeast of Bahia; MS = Metropolitan of Salvador; CSB = Central South of Bahia; SB = South of Bahia. Source: IBGE (2023).

The smaller plantation areas observed in the mesoregions of the Central South of Bahia (where 56.6% of the municipalities have plantations smaller than 200 ha) and the Central North (where 100% of the municipalities have plantations smaller than 200 ha) merit particular attention. This pattern is also observed in the mesoregion of the Valley of São Francisco, which notably lacks forest plantations.

The conspicuous absence of eucalyptus plantations in regions characterized by a semiarid climate raises important considerations. As stated by Rodrigues et al. (2021), this phenomenon may be associated with the insufficient promotion of forestry activities in these areas.

The increased market liquidity and reduced costs associated with firewood production, combined with a short harvesting cycle of four to five years, have been shown to generate a rapid return on investment (ALVES et al., 2011; FLOR, 2014). This is strategically important for meeting the demand of the São Francisco Valley and the Central North mesoregion, making the expansion of areas dedicated to this activity essential.

The 'Mais Árvores Bahia' Program, which aims to decentralize the local economy, has shown limited effectiveness because it does not adequately reach municipalities without established forest plantations, such as small rural properties located in semiarid regions. These regions, characterized by low human and economic development (SOUZA & LOPES, 2022), present an economic opportunity through the production and commercialization of value-added wood products derived from forestry activities.

Considering also that one of the incentives of this program is the promotion of integrated crop-livestock-forestry systems (ICLF), this approach has the potential to serve as an economic alternative capable of supplementing household income, since the forestry component of ICLF systems enables wood production at younger ages.

The possibility of generating an early return on investment through crop rotation is one of the main advantages of the program (LIMA & GAMA, 2018; GASPERINI & GOMES, 2020; CARVALHO et al., 2020; ABAF, 2022). These initiatives, institutionalized by companies and government agencies, could contribute to combating the illegal extraction and commercialization of wood from protected native areas.

Spatial distribution of eucalyptus plantations in Bahia

As shown in Figure 2, the areas with the highest concentration of eucalyptus forest plantations, ranging from 58,000 to 340,000 ha, were concentrated in specific portions of the Northeast, South, and Central South regions of Bahia, in addition to adjacent areas with lower plantation density distributed throughout these regions.

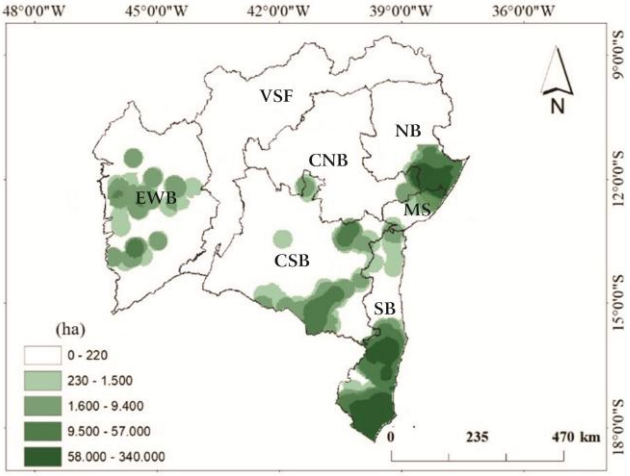

Figure 2. Density of eucalyptus forest plantations distributed across the mesoregions of the State of Bahia, Brazil. Scale: 1:250,000 Brazilian Geodetic System DATUM Sirgas 2000. Source: WRI/GFW (2022); BRASIL (2022b). VSF = Valley of São Francisco; EWB = Extreme West of Bahia; CNB = Central North of Bahia; NB = Northeast of Bahia; MS = Metropolitan of Salvador; CSB = Central South of Bahia; SB = South of Bahia.

This demonstrates that the strategic planning adopted by companies to concentrate plantations as close as possible to their industrial yards or processing facilities is a key factor in the formation of dense eucalyptus plantation clusters. This pattern is mainly associated with the need to reduce transportation distances in forestry operations.

Transport distances exceeding 100 km, especially between 150 and 200 km, substantially increase wood transportation costs, thereby raising overall production costs (LOPEZ et al., 2009; GADELHA et al., 2015). Moreover, the primary factor influencing corporate integration into plantation ownership through partnerships and land leasing arrangements is the uncertainty surrounding wood supply transactions (LISBOA, 2009). To expand eucalyptus cultivation areas, the implementation of tax incentives is crucial to stimulate the establishment of new wood-processing industries in Bahia, particularly in municipalities where forestry activities are still absent.

The formation of concentrated and well-defined eucalyptus plantation clusters in Bahia has resulted in a scarcity of these plantations from the central to the northern portions of the state, especially in the semiarid regions of Bahia.

In addition to transportation costs, the expansion of eucalyptus forestry into semiarid regions also faces climatic limitations, mainly due to water scarcity characteristic of this Brazilian region (BRITO et al., 2022), which may render eucalyptus cultivation unfeasible under certain conditions (AZAM et al., 2012; GONÇALVES et al., 2017; APARECIDO et al., 2025). Therefore, it is necessary to establish research programs focused on genetic improvement, including studies involving provenances, progenies, and specific clones of more adaptable species, such as *Eucalyptus camaldulensis*, adapted to the climatic conditions of semiarid regions.

Wood production by segment

Eucalyptus wood production in the State of Bahia reached 6,637,169.00 m³ in 2022, with most of the production destined for the pulp and paper sector, which accounted for 81.6% of the total (5,416,651.00 m³), followed by firewood production for energy purposes, representing 17.3% (1,147,142 m³). Only 1.1% (73,376.00 m³) of total log production was destined for other purposes, such as civil construction, stakes, fence posts, and related uses.

Part of the wood production (not quantified directly) was converted into charcoal, totaling 157,848.00 tons (Figure 3). However, assuming a wood density of 0.70 g cm^{-3}, the estimated volume of wood converted into charcoal was approximately 225,497.14 m³.

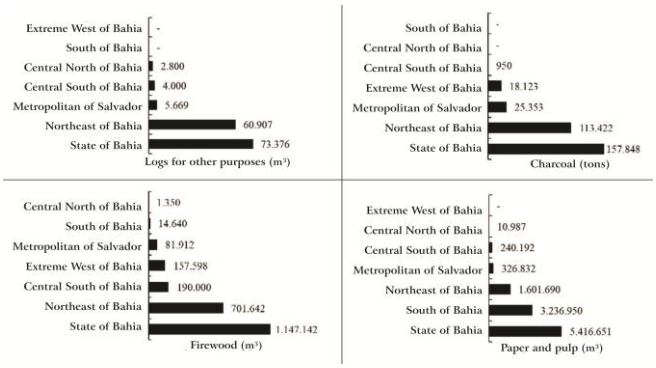

Figure 3. Distribution of eucalyptus wood production by segments across the mesoregions in the State of Bahia, Brazil.

In addition, according to Figure 3, the largest wood production destined for the pulp and paper sector occurred in the South of Bahia, representing 59.8% of the total production in this segment within the State of Bahia, followed by the Northeast of Bahia (29.6%). For the other production segments, the Northeast of Bahia accounted for the largest share among the mesoregions, representing 83% of the wood destined for other

purposes, 61.2% of firewood production, and 71.9% of charcoal production in the state.

The low production of wood for the energy sector (firewood and charcoal) may be associated with the export-oriented production model that guides eucalyptus forestry in Bahia, especially the emphasis on wood pulp production (BIAZUS et al., 2010; VIDAL & HORA, 2012; BRAINER, 2021). For example, the companies Veracel, located in Eunápolis, and Bracell, located in Camaçari, both in Bahia, are major representatives of the pulp production sector.

Furthermore, the combination of the limited presence of planted forests in semiarid regions of the state and the low production of firewood and charcoal for specialized markets restricts the supply of wood available to meet local energy demands. In addition, it should be emphasized that part of the firewood and charcoal market is directed toward the steel industry (BRAINER, 2019), as observed in the Northeast mesoregion, where wood production is directed almost exclusively toward charcoal production for steelmaking.

Moreover, the scarcity of management plans for Caatinga vegetation limits its capacity to meet regional energy demands (GADELHA et al., 2015; GAMA, 2021).

Therefore, the demand for phytomass as an energy source in semiarid regions can be effectively addressed through the use of eucalyptus wood, particularly by selecting resistant or tolerant genetic materials. Notably, *Eucalyptus camaldulensis* Dehnh. demonstrates strong adaptation to environments characterized by low rainfall and high temperatures (GONÇALVES & PASSOS, 2000; REIS et al., 2003; DRUMOND et al., 2004; MENDONÇA et al., 2012; VALE et al., 2014). This species is recognized for its capacity for rapid regrowth and high growth rates (COSTA et al., 2024). Furthermore, eucalyptus presents a short rotation cycle, facilitating a rapid supply of wood (ALVES et al., 2011; VALE et al., 2014; FLOR, 2014; RODRIGUES et al., 2021; OLIVEIRA & PINTO JUNIOR, 2021).

The underrepresentation of eucalyptus plantations has been shown to significantly influence price dynamics and intensify pressure on native forests as sources of wood products from both the Caatinga and Cerrado biomes, given the strong regional demand for energy derived from firewood and charcoal. This demand is associated with sectors such as ceramics, plaster production, pottery, the sugar and alcohol agroindustry, bakeries, agricultural inputs, and residential consumption, among others (GADELHA et al., 2015; RODRIGUES et al., 2021; GAMA et al., 2023; SANTOS JÚNIOR et al., 2023).

This scenario may contribute to increased extraction of native wood, especially firewood, charcoal, and logs intended for local consumption and other direct uses.

CONCLUSIONS

The study revealed an imbalance in the distribution of forest plantations and wood production among the specialized segments across the mesoregions of Bahia.

The distribution of eucalyptus plantations in Bahia is concentrated along coastal and peripheral areas, distant from the interior of the state, forming distinct plantation clusters according to mesoregions and exhibiting a high concentration of planted areas within a small number of municipalities. This pattern indicates a limited representation of planted forests in the interior of the state, particularly in the Central North mesoregion, as well as a complete absence in the Valley of São Francisco mesoregion**.**

The largest eucalyptus wood production occurs in the Northeast of Bahia mesoregion, except for wood destined for the pulp and paper sector, which is produced predominantly in the South of Bahia.

Given the current scenario, the promotion of eucalyptus cultivation in less favored regions, especially on small rural properties in the semiarid region of Bahia, represents an important alternative for reducing regional inequalities**.** In addition, it has the potential to produce value-added wood for local consumption, thereby contributing to the reduction of logging pressure on native forests.

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