

# PARTICIPATION OF SILVICULTURE PRODUCTS IN THE GROSS DOMESTIC PRODUCT OF THE BRAZILIAN FOREST-BASED SECTOR FROM 2000 2019

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## Resumo

*Participation of silviculture products in the gross domestic product of the brazilian forest-based sector from 2000 2019.* Este estudo teve como objetivo analisar a evolução e participação dos produtos da silvicultura no Produto Interno Bruto (PIB) do setor de base florestal brasileiro, no período de 2000 a 2019. Para isso, utilizou-se de dados secundários coletados junto ao IBGE - Instituto Brasileiro de Geografia e Estatística, considerando séries históricas referentes a quantidade produzida/comercializada na silvicultura (m<sup>3</sup>) e valor da produção na silvicultura (Mil reais) no Brasil. Para obtenção da evolução do preço (P) de cada produto aplicou-se a equação, utilizando o quociente entre o valor da produção e suas respectivas quantidades produzidas. Já as análises de evolução do PIB, foram conduzidas por meio do cálculo da taxa geométrica de crescimento (TGC). Verificou-se que o PIB nominal dos produtos da silvicultura apresentou constante ascensão até o ano de 2012, com declínio após este ano. Já em relação ao PIB Real o comportamento de declínio iniciou em 2011, no entanto de maneira mais moderada. O PIB real do Brasil, apresentou uma taxa positiva 3,51%, diferente da taxa da silvicultura que se mostrou negativa para todos os produtos, desencadeando em um declínio na taxa do setor florestal. Assim, concluiu-se que as crises financeiras e mudanças mercadológicas impactaram alguns produtos da silvicultura com maior intensidade que outros, principalmente durante os anos de recessão.

*Palavras-chave:* Indicadores econômicos; Macroeconomia; Mercado

## Abstract

*Evolution and participation of forestry products in the gross domestic product of the Brazilian forest-based sector, in the period of 2000 to 2019.* This study aimed to analyze the evolution and participation of forestry products in the Gross Domestic Product (GDP) of the Brazilian forest-based sector, from 2000 to 2019. To do so, secondary data collected from Instituto Brazilian Geography and Statistics, considering historical series referring to the produced/commercialized quantity in silviculture (m<sup>3</sup>) and production value in silviculture (Thousand dollars). To obtain the price evolution (P) of each product, the equation was applied, using the quotient between the value of the production and its respective produced quantities. The analysis of the evolution of the GDP, on the other hand, was conducted by calculating the geometric growth rate (GGR). In relation to the real GDP, the decline started in 2011, however in a more moderate way. The real Brazilian GDP presented a positive rate of 3.51%, different from the silviculture rate that was negative for all products, triggering a decline in the forestry sector rate.

*Keywords:* Economic indicators; Forest economy; Financial crises; Macroeconomics; Marketplace.

## INTRODUÇÃO

The Gross Domestic Product (GDP) stands as one of the most widely used macroeconomic indicators aimed at quantifying the economic activity of a specific region. Furthermore, it seeks to measure the wealth produced within a specific period and can present positive and negative values depending on the scenario of the activities it encompasses (PASSOS *et al.*, 2012).

Therefore, due to the fact that Brazil is a large country, it becomes crucial to have a more comprehensive assessment that encompasses all the different regional realities. In this sense, the GDP is composed of all the gross values of the major sectors of the country's economy, such as agriculture, industry, and services (SOUZA *et al.*, 2015). Among the activities of these major sectors, silviculture is characterized by forest management and the use of techniques for extractive or cultivated forest production, aiming to meet market demands and promote the rational use of forests.

From the perspective of the supply chain of cultivated forests, there is a set of activities and segments that range from production to the transformation of wood into forest-based products and byproducts. The

significance of this chain for the development of the Brazilian economy was evaluated in scientific studies, such as those by Moreira *et al.* (2017); Barbosa *et al.* (2020); Ribeiro *et al.* (2020); Souza *et al.* (2021);

According to IBA (2020), in the year 2019, this segment contributed to a sectoral GDP of BRL 86.6 billion, representing 2.4% of Brazilian GDP and 6.9% of industrial GDP. This scenario is given by the fact that forest products demonstrate highly competitive in both domestic and international markets, due to edaphoclimatic attributes and the technological advancements applied in silvicultural and forest management practices.

In this regard, understanding the contribution of the sector to the economy over the years is of utmost importance for the development of economic activities, so that subsidies can be obtained in the formulation of economic strategies and policies that allow silviculture to be enhanced. However, there are limitations in estimating the GDP of the sector due to the lack of comprehensive data and information that accurately represent the reality of the activities.

In light of the above, the present study aimed to analyze the evolution and participation of silviculture products in the Gross Domestic Product (GDP) of the Brazilian forest-based sector, in the period from 2000 to 2019.

## MATERIAL E MÉTODOS

### Data source

This study was conducted based on secondary data collected from IBGE - Brazilian Institute of Geography and Statistics (2021). To achieve this, we worked with historical series referring to the quantity produced/sold in silviculture (m<sup>3</sup>) and the value of production in silviculture (thousand reais) in Brazil, between the period 2000 and 2019. The nomenclatures presented by IBGE statistics 'Production of Vegetable Extraction and Silviculture' were considered, as shown in Table 1.

Table 1. Destinations, sub-destinations, and species used by type of silviculture product.

Tabela 1. Destinações, sub destinações e espécies utilizadas por tipo de produto da silvicultura.

Destinations	Sub destinations and species
Charcoal (t)	Eucalyptus spp.
	Pinus spp.
	Other species
Firewood (m3)	Eucalyptus
	Pinus spp.
	Other species
Roundwood (m3)	Paper And Pulp
	Eucalyptus spp. for paper and pulp
	Pinus spp. for paper and pulp
	Other species for paper and pulp
	Other purposes
	Eucalyptus spp. for other purposes
Pinus spp. for other purposes	
Other species for other purposes	
Other products (t)	Black Acacia (bark)
	Eucalyptus (leaf)
	Resin

Source: IBGE, (2021).

Brazil is highly competitive in the forest products market due to its edaphoclimatic characteristics (soil and climate) and the technological advancements achieved in the silviculture field. The Forestry Sector is considered a highlight in the production chain of the Brazilian economy. In 2019, the estimated production value of the sector was BRL 134.5 billion. Summarizing, out of a total of 50 activities representing the entire Brazilian economy; the productive chain of planted trees ranked 22nd as the activity with the greatest contribution to the Brazilian gross domestic product (GDP) (IBÁ, 2021).

In this context, the silviculture production chain utilizes charcoal and unprocessed firewood as sources of energy. The production of charcoal in Brazil serves the steel and metallurgical industries, among others.

Meanwhile, unprocessed firewood is primarily destined for the domestic market and is used for agricultural, livestock, and residential purposes.

Roundwood, on the other hand, is categorized according to its diameter classes, usage, and type of industrial processing. This raw material undergoes various transformation and processing procedures and can be used in industrial activities, such as: paper and pulp, civil construction, furniture manufacturing, among others.

In the IBGE classification, products classified as 'other' correspond to the tannin removed from the bark of the Black Acacia species, which serves industries like pharmaceuticals, tanneries (leather), among others. Eucalyptus leaves, which are used for essential oils also find a wide usage in the pharmaceutical industry. And finally, resin, which is a non-timber forest product extracted from certain species within the Pinus genus, With rosin and turpentine as its byproducts.

### Data analysis and processing

The value of production in silviculture (VP) is configured as a derived variable, calculated by the weighted average of the information on quantity produced (m<sup>3</sup>) and the average current price (BRL/m<sup>3</sup>) paid to the producer, according to the harvest and sales periods for each product. Freight charges, fees, and taxes are not included in the price.

Thus, to obtain the evolution of the price (P) of each destination, the equation was applied, using the quotient between the production value and the respective quantities produced for the same period (Equation 1).

$$P = \frac{VP}{QP} \quad (1)$$

Where: P = price (BRL/m<sup>3</sup>); PV = value of production (BRL); QP = quantity produced (m<sup>3</sup>).

The prices were deflated to the year 2019 using the Broad Consumer Price Index – IPCA, based on September 2000, an index published by IBGE, Directorate of Research, Price Index Coordination (NATIONAL SYSTEM OF CONSUMER PRICE INDEXES, 2020).

### Estimates of GDP

The data on Brazil's GDP, used to assess the contribution of the GDP of silviculture products to the Brazilian GDP, are from IBGE and are available on the website of the Institute of Applied Economic Research - IPEA (IPEA, 2021) It is worth noting that to analyze the behavior of a country's GDP over time, it is essential to differentiate between Nominal and Real GDP.

Consequently, as proposed by Passos and Nogami, (2006) the Nominal GDP was calculated at current prices (Equation 2) and the Real at constant prices in which the base year of 2000 was used empirically, eliminating the effect of inflation (Equation 3).

$$Nominal\ GDP = \sum_i^n (P_{in} * Q_{in}) \quad (2)$$

Where: P = price, Q = amount produced, i = product, and n = period.

$$real\ GDP = \left( \frac{Nominal\ GNP}{Price\ Index} \right) * 100 \quad (3)$$

For more representative assessments aiming to obtain the real value that takes into account variations in the quantities of goods produced and changes in market prices, the General Price Index – Internal Availability (IGP-DI) and the Annualized inflation rate from the Getúlio Vargas Foundation (FGV) were used (IPEA, 2021).

It is worth noting that, for GDP measurement, precautions were taken to avoid double counting, that is, to avoid considering an asset twice in the calculation and not overestimating it. Thus, intermediate goods were excluded as they were already added to the value of the final product.

### GDP Evolution

For the analysis of GDP evolution, the calculation of the geometric growth rate (GGR), as proposed by Gujarati (2004), was conducted. This model is used to calculate the growth rate of economic variables, such as population, GDP, money supply, employment, productivity, and trade deficit, according to Equation 4.

$$Y = a * b^T \quad (4)$$

Where: Y = dependent variable; T = time; a and b = parameters to be estimated.

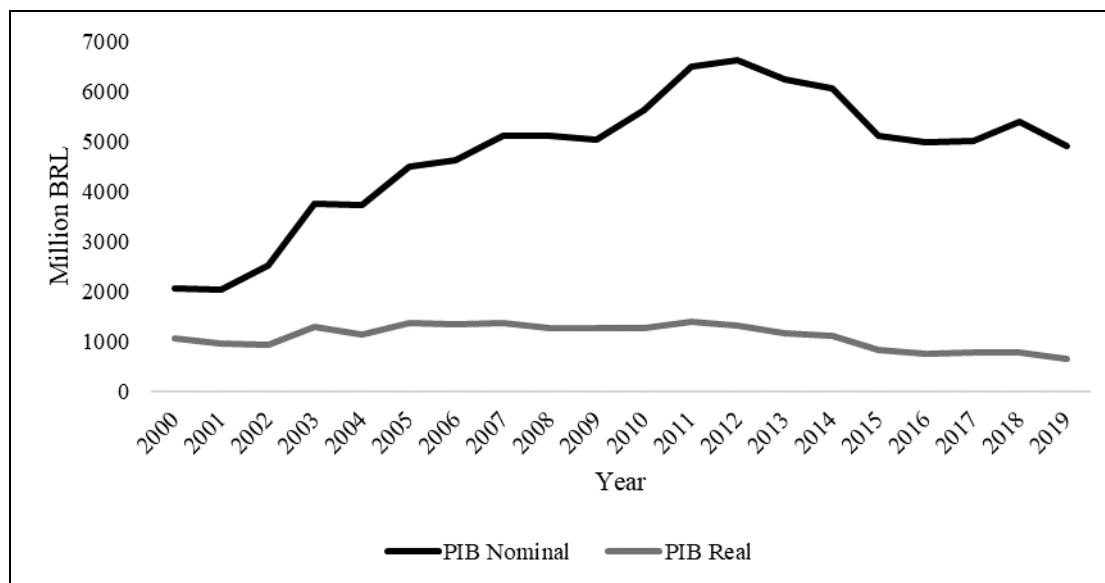
Subsequently, the logarithmic form was applied, according to Equation 5, and the GGR was obtained according to Equation 6.

$$\text{Log}Y = \log a + T \log b \quad (5)$$

$$\text{TGC} = (\text{Anti} - \log b - 1) * 100 \quad (6)$$

## RESULTS

The Brazilian forestry economy plays a role in the socioeconomic indicators of the country, such as the Gross Domestic Product (GDP). The estimates of the Nominal and Real GDP of silviculture products during the assessed period are shown in Figure 1.



Source: Authors, 2021.

Figure 1: Estimates of the Nominal and Real GDP of Silviculture products.

Figura 1: Estimativas do PIB Nominal e Real dos produtos da Silvicultura.

It can be observed that the nominal GDP of silviculture products showed a constant increase until 2012, showing a decline after that year. In other ways, concerning the Real GDP, the declining trend started in 2011, albeit in a more moderate manner. This scenario is due to price fluctuations, in which the declines from 2012 onwards are attributed to the deceleration cycle caused by the drop in the investment rate in this segment, which reached negative levels. This retraction can be attributed to issues such as shortcomings in the implementation of economic policies, a rapid drop in commodity prices, and factors related to institutional and legal matters.

In the year 2009, despite the strong impacts of the global crisis, some silviculture products continued to grow due to effective public policies and efficient actions in certain business and private sectors. This fact is confirmed by the positive indicators that prove the dynamism of investments (CIFLORESTAS, 2016). In some regions, however, products within this segment exhibited a different behavior, including an increase in unemployment due to the crisis.

In the national economic context of 2014, there was an economic slowdown and low confidence in government spending, which contributed to various segments of the silvicultural sector focused on the domestic market maintaining only acceptable levels of business (CIFLORESTAS, 2016). One of the characteristics of the period was a severe recession, which led to a decline in the Gross Domestic Product (GDP) for two consecutive years.

According to Rossi *et al.*, (2017) in the year 2015, due to the fragility of the Brazilian economy, the government implemented a recessionary shock, resorting to a set of economic austerity policies. Furthermore, the objective of this stance was to address imbalances in the Brazilian economy that concerned both public accounts and administered prices. These decisions are in line with Teixeira (2018) who suggests that countries offering appropriate regulatory systems create competitive advantages and stimulate sectoral economies.

"From the perspective of the conjunctural analysis by (Ciflorestas, 2016), forestry businesses maintained constant standards, especially those ventures dedicated to the domestic market that presented

disappointing results due to the economic crisis. It's worth noting that from the perspective of the external market, many companies faced a different scenario, even expanding their businesses. Such market behavior corroborates that emphasized by Mensah (2012), who highlights that the factors shaping the political, institutional, and regulatory environment directly influence investment attractiveness.

Based on the overview of the forestry sector in Table 2, the participation of silviculture forest products can be observed from 2000 to 2019.

Table 2: Participation of the GDP of the Brazilian forestry sector (%), nominal and real GDP (BRL Million) and participation of the GDP silviculture product GDP in the sectoral GDP (%), during the period from 2000 to 2019.

Tabela 2: Participação do PIB do setor florestal brasileiro (%), PIB nominal e real (Milhões R\$) e participação do PIB dos produtos da silvicultura no PIB setorial (%), durante o período de 2000 a 2019.

Year	Forestry Sector	Charcoal			Firewood			Roundwood			Others		
	P	N	R	P	N	R	P	N	R	P	N	R	P
2000	0.17	365	188	17.7	403	208	19.5	1254	647	60.8	42	188	2.0
2001	0.16	315	147	15.4	305	143	14.9	1403	655	68.6	21	147	1.0
2002	0.17	453	167	18.0	447	165	17.7	1506	556	59.7	115	167	4.6
2003	0.22	760	261	20.3	391	134	10.4	2538	871	67.8	56	261	1.5
2004	0.19	538	165	14.5	557	170	15.0	2527	773	68.0	94	165	2.5
2005	0.21	552	167	12.2	549	166	12.2	3292	995	73.1	113	167	2.5
2006	0.19	615	179	13.3	581	169	12.5	3357	977	72.4	82	179	1.8
2007	0.19	977	264	19.2	686	185	13.4	3378	912	66.2	61	264	1.2
2008	0.16	1178	291	23.0	732	181	14.3	3156	781	61.7	48	291	0.9
2009	0.15	834	209	16.6	750	188	14.9	3393	852	67.5	50	209	1.0
2010	0.15	888	200	15.8	858	194	15.2	3817	861	67.7	74	200	1.3
2011	0.15	1079	232	16.6	966	208	14.9	4383	941	67.4	75	232	1.2
2012	0.14	1123	223	16.9	1045	208	15.8	4399	874	66.4	62	223	0.9
2013	0.12	1159	218	18.6	1025	193	16.4	3997	753	64.0	62	218	1.0
2014	0.10	1330	241	21.9	1020	185	16.8	3625	658	59.8	90	241	1.5
2015	0.09	932	153	18.2	856	140	16.8	3211	526	62.8	110	153	2.1
2016	0.08	887	136	17.8	784	120	15.8	3185	487	64.1	117	136	2.4
2017	0.08	924	142	18.4	769	118	15.3	3207	492	63.8	123	142	2.5
2018	0.08	1346	193	25.0	705	101	13.1	3209	460	59.5	132	193	2.5
2019	0.07	1239	165	25.2	683	91	13.9	2855	380	58.1	134	165	2.7

Note: N = Nominal GDP (BRL Million); R = Real GDP (BRL Million); P = Participation of GDP of the forestry sector (%).

Source: Authors, 2021.

## DISCUSSION

Aiming to have a clearer understanding of the reality of the sector, real GDP was used to verify the behavior of silviculture products in the forest-based sector over time (SOARES *et al.*, 2014).

From this perspective, the effects of this economic behavior reached the charcoal segment, which according to Dias *et al.* (2015) places Brazil as the largest producer and consumer of this product, mainly in the steel industry. Therefore, it can be seen that from 2014 onwards there was a decline, due to lower demand for iron, causing a drop in prices in the main markets and consumers of the product. Subsequently, in 2018, the Brazilian share of charcoal consolidated the country as a world leader in the production of steel from this product (CEPEA, 2018).



From the perspective of wood for energy, such as firewood, it can be observed that over the years there has been a reduction in its share of Real GDP. This situation is mainly due to the fact that energy sources are being replaced by new forms of energy, such as companies that have adopted automated and more efficient burning systems. However, this silvicultural product still represents a significant portion of the energy matrix, even with predominantly regional use.

As discussed by Simioni *et al.* (2017) the use of this biomass of forest origin constitutes a renewable energy alternative. According to data from the National Energy Balance in 2014, the domestic supply of renewable energy sources such as firewood and charcoal accounted for 39.4%, indicating a decrease in hydraulic energy in Brazil (EMPRESA DE PESQUISA ENERGÉTICA – EPE, 2015).

On the other hand, roundwood is the largest contributor to the forestry GDP, encompassing different segments depending on its use or the industrial processing it is intended for. Until the year 2011, the real GDP of the segment had been showing small fluctuations, in line with the discussion of the deceleration cycle and price volatility. According to APRE (2020), the significant reduction in roundwood in Brazil after 2012 can be attributed to the decrease in the production of Eucalyptus and Pine logs.

Other forestry products had the lowest share (%) of forestry GDP; however, they encompass activities of great importance, such as resin, which generates a quick economic return, resulting in an annual revenue stream. Moreira *et al.* (2016), In 2016, when evaluating the gum resin market, they pointed out that the economic activity faced challenges related to high-interest rates, a labor shortage, and the formation of an oligopsony, which led to a reduction in the price of gum resin.

The decline in the real GDP related to Black Acacia bark can be attributed to the drop in international prices, due to the international crisis and the appreciation of the Brazilian real against the dollar, which affected revenues starting from 2009 (SUYENAGA *et al.*, 2015)

In Table 3, the GGR (% year) of nominal GDP and real GDP of Brazil, the forestry sector and silviculture products in the period from 2000 to 2019 are shown.

Table 3: Geometric growth rate (GGR) of GDP, 2000 to 2019.

Tabela 3: Taxa geométrica de crescimento (TGC) do PIB, 2000 a 2019.

Variables	GGR (% year)	
	Nominal GDP	Real GDP
Brazil	10.43	3.51
Forestry sector	4.41	-2.13
Coal	6.16	-0.49
Firewood	4.52	-2.03
Roundwood	3.92	-2.59
Others	4.88	-0.49

Source: Authors, 2021.

The Brazilian economy since the early 2000s has exhibited a pattern of alternating between small cycles of growth and economic decelerations, often marked by abrupt changes. Thus, the effects of the crises are reflected in the GDP indicators, which have been showing negative rates in some segments. For many forestry companies, survival has been challenging. However, some, due to their strong consolidation and capitalization, are less affected, as is the case with the pulp and paper industry (DEPAULA *et al.*, 2017).

In this context, it appears that in the period assessed, Brazil's real GDP presented a positive rate of 3.51%, different from the forestry rate, which was negative. In recent decades, the forestry sector has undergone significant legislative changes, directly influencing the behavior of the GDP Studies like that of Ferreira *et al.* (2015) indicate that the forest code can have economic impacts, as losses of small areas can affect numerous forest producers and, consequently, the industry.

Considering silviculture products, it was found that the real GDP of all products presented a negative geometric growth rate, as is the case of roundwood with -2.59% per year. As explained by Soares *et al.* (2014) factors such as the lack of efficient public policies in taxation, interest, and exchange rates, as well as the shortcomings in specific aspects of legislation, can explain the attenuation of the contribution of the study sector to the national GDP.

Silvicultural products such as charcoal and others presented a rate of -0.49%, unlike products such as firewood and round wood, where the results were even more discouraging. These situations collaborate with those discussed by Moreira and Oliveira (2017), who stated that each silviculture product has specific markets and is interdependent due to the conditions for its development being associated with the forestry base. However, the sector has a specific dynamic, determined by the supply of wood and forest productivity.

In this way, it becomes essential to understand the reality and potential of each investment, making informed decision-making more assertive in companies and the silvicultural products industry (FERREIRA *et al.*, 2013).

## CONCLUSIONS

Based on the findings of this study, it can be concluded that:

- Globalization has brought about significant changes in forestry sector markets, affecting competitiveness, business attraction, and forest investments, all of which have a direct impact on the GDP.
- Silvicultural products play a significant role in the forest GDP, especially roundwood, which accounts for over half of the shares and consequently showed the highest growth rate.
- Based on the scenario presented in this study, it is recommended that the government implement reforms that promote the growth of activities in the sector, stimulating the development and increasing the geometric rate of silvicultural products in the coming years.
- Another point of fundamental importance in maximizing sectoral indicators concerns technological development, aiming to expanding forest production and industries in the national sector. This will help maintain industrial competitiveness in the long term and strengthen the position of some organizations in the sector that are still at a competitive disadvantage.
- In this regard, it is recommended that further studies be conducted, considering a greater number of products, to provide a broader understanding of the impacts of the forest sector on the Brazilian GDP over the years. For future research, it is suggested to apply the methodology to assess the impact of the pandemic on the GDP in comparison to previous years.
- Furthermore, this study had the limitation of data availability in more specific detail, making it challenging to engage in more individualized discussions that consider the various activities encompassing silviculture products.

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