Behavior of the world sawn wood market of non-coniferous tropical species between 1990 and 2018

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ABSTRACT

For the knowledge of the dynamics of the world timber market, it is necessary to monitor and understand its trends. Given the above, the objective was to evaluate the behavior of Brazil in the world market for sawn wood non-coniferous tropical and to analyze the trends of production, export, and import of the most expressive countries in this market. The data studied were made available by the International Tropical Timber Organization. The growth geometric rate in m³ and dollars was calculated for the analysis of the behavior of the production, export, and import of sawn wood. In all the countries studied, there was a tendency to reduce the production of sawn wood. Brazil, Malaysia, and Indonesia showed a fall in sawn timber exports. Sawn wood has appreciated on the world market, due to the increase in the value of wood about the volume exported. China is the country that most imports sawn wood with a constant growth trend, in addition to having the highest value of wood among the other countries studied. The preservation of the environment, the economic slowdown, and the replacement of wood by equivalent products are the main factors responsible for the drop in world production.

Keywords: Geometric growth rate, Sawn wood exports, Sawn wood imports, Sawn wood production.

Comportamento do mercado mundial de madeira serrada de espécies tropicais não coníferas entre 1990 e 2018

RESUMO

Para o conhecimento da dinâmica do mercado mundial de madeira, é necessário monitorar e compreender suas tendências. Dado o exposto, o objetivo foi avaliar o comportamento do Brasil no mercado mundial de madeira serrada tropical não conífera e analisar as tendências de produção, exportação e importação dos países mais expressivos nesse mercado. Os dados estudados foram disponibilizados pela Organização Internacional de Madeira Tropical. A taxa de crescimento geométrico em m³ e dólares foi calculada para a análise do comportamento da produção, exportação e importação de madeira serrada. Em todos os países estudados, houve uma tendência de redução na produção de madeira serrada. Brasil, Malásia e Indonésia apresentaram uma queda nas exportações de madeira serrada. A madeira serrada valorizou-se no mercado mundial devido ao aumento do valor da madeira em relação ao volume exportado. A China é o país que

mais importa madeira serrada, com uma tendência de crescimento constante, além de possuir o maior valor de madeira em comparação com os outros países estudados. A preservação do meio ambiente, a desaceleração econômica e a substituição da madeira por produtos equivalentes são os principais fatores responsáveis pela queda na produção mundial.

Palavras-chave: Taxa de crescimento geométrico. Exportações de madeira serrada. Importações de madeira serrada. Produção de madeira serrada.

INTRODUCTION

Wood is an important natural resource, being fundamental in various market segments, whether in civil constructions, packaging, energy source, and cellulose (VIDAURRE et al., 2011). The historical use and versatility of wood make the forestry sector essential for global economic development (GRANT et al., 2013). Only the sawn wood non-coniferous tropical market moved more than $11 billion in 2018 (INTERNATIONAL TROPICAL TIMBER ORGANIZATION, 2020), demonstrating the importance of the forestry sector in the global economy.

The study of market trends and strategies directed by producing and purchasing countries is necessary to understand the dynamics of the world wood market, because although forest resources are within the borders of countries, the consequences of their use or preservation may have implications global (BERNSTEIN et al., 2010).

Global economic growth is one of the main indicators of demand for tropical timber products due to their impacts on the construction sector, especially civil (INTERNATIONAL TROPICAL TIMBER ORGANIZATION, 2017). The increased world trade in timber products, mainly unprocessed wood, has alerted several countries, both for environmental and economic reasons (SUN, 2017).

Initiatives such as the EU FLEGT Action Plan (Action Plan for the Implementation of Forest Legislation, Governance, and Trade of the European Union), Forest Certification, and customs fees, are measures that some countries adopt to protect the country's economy and especially the protection of its forests (SIMEONE, 2012; LESNIEWSKA; MCDERMOTT, 2014; MCDERMOTT et al., 2015).

In this context, the objective was to evaluate the behavior of Brazil in the world market for sawn wood non-coniferous tropical and to analyze the trends of production, export, and import of the most expressive countries in this market.

MATERIAL AND METHODS

The database for the analysis of the sawn wood market of non-coniferous tropical was obtained from the International Tropical Timber Organization (ITTO) website. Data on the production, export, and import of sawn wood in cubic meters (m³) and dollars (US$) were considered for the most representative countries on the market in quantitative terms (m³) in the period from 1990 to 2018. The structure of the study included the analysis of production from Brazil, Indonesia, Thailand, and Vietnam; export from Brazil, Cameroon, Malaysia, and Thailand; and imports from Brazil, China, the United States, and Thailand.

Growth geometric rate

The dollar values of the export and import of sawn wood for all years obtained by ITTO have been corrected according to the average annual inflation of each country. Selecting 2018 as the base year, the values were corrected using the average General Market Price Index (IGPM) for the year 2018 of each country. The values of the rates used were obtained at the Macrotrends website.

To analyze the trends of the export and import of sawn wood, the growth geometric rate (GGR) was calculated, which allows analyzing the behavior of the variables considered as a function of time. The rate can be calculated based on the compound interest formula (Equation. 1) as Gujarati; Porter (2011).

$$Y_t = Y_0(1 + r)^t \tag{1}$$

In which: r is the growth geometric rate (over time) of Y; Y_t are the final export and import, in m³ and US$, of the countries, analyzed; Y_0 are the initial export and import values, in m³ and US$, of the countries, analyzed; t is the period considered.

Applying the natural logarithm (ln) to Equation 1, we have:

$$lnY_t = lnY_0 + t \, ln(1 + r) \tag{2}$$

Making $\beta_1 = lnY_0$ and $\beta_2 = ln\,(1 + r)$ replacing Equation. 2, has:

$$lnY_t = \beta_1 + \beta_2 t \qquad (3)$$

To obtain the GGR, a stochastic error term (ε) was added in Equation 3 and adjusted the linear regression model (Equation 4).

$$lnY_t = \beta_1 + \beta_2 t + \varepsilon \qquad (4)$$

In *which:* Yt are export and import values in m³ and US$, of the countries, analyzed over time t; β_1 and β_2 are the regression coefficients.

After adjusting the regression model, to obtain the GGR (Equation. 5), it isolates *r in* the relationship, $\hat{\beta}_2 = ln (1 + r)$ then:

$$r = e^{\hat{\beta}_2} - 1 \qquad (5)$$

The adjustment of the linear regression model was performed in the Software R version 3.6.2 (RStudio Team, 2016), using the ordinary least squares method.

Analysis of sawn timber sales prices

Silva et al. (2012) reports that the verification of the selling price trend of sawn wood can be performed by comparing the geometric rate of growth in cubic meters and dollars. If the growth geometric rate in cubic meters is higher than that in dollars, wood is losing market value, because the volume sold is growing more than the value of wood. Otherwise, wood is gaining market value.

RESULTS AND DISCUSSION

Production

Brazil has a trend of production growth, which remained practically constant until the middle of 2007 (Figure 1). Until 2012, it was the world's largest producer of sawn wood. However, after 2007, there was a sharp drop in production of approximately 81.70%, based on 2016. After this period, production remains stable until 2018.

Figure 1 – Historical series of sawn wood non-coniferous tropical production in a cubic meter of Brazil (BRA), Indonesia (INA), Vietnam (VIE), and Thailand (THA), from 1990 to 2018. The x-axis is represented by the period, and the y-axis is the production data multiplied by a thousand.
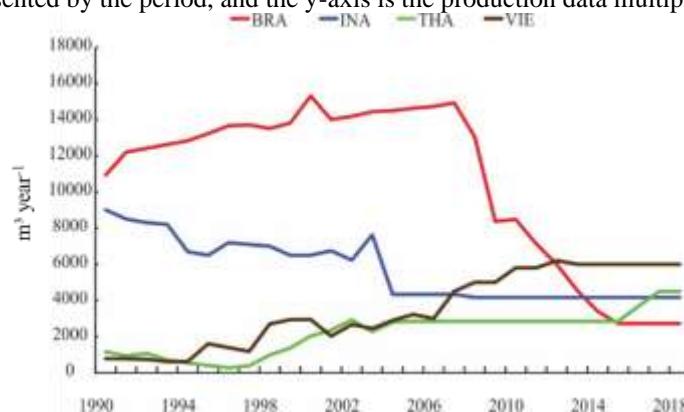
Indonesia showed a downward trend in production throughout the historical series, except for 1995 and 2002, which showed an increase of 10.77% and 22.31%. As of 2004, sawn wood production practically stabilized until the end of the historical series (Figure 1).

Vietnam had the lowest timber production in the countries considered at the beginning of the historical series (Figure 1). Since 1990, it has had a steady growth in production throughout the period considered, and in 2016 it was the largest producer of sawn wood, among the countries, considered.

Thailand showed a 75.64% drop in wood extraction from 1990 to 1996. Between 1996 and 2004, there was a growth of almost nine times in production (Figure 1). From 2004 to 2018, the figures are practically constant, with a peak in production of 29.82% in 2016 compared to the previous year.

The drop in Brazilian production may be associated with the global crisis of 2008, the appreciation of the real against the dollar, resulting in loss of competitiveness of the sector concerning other tropical countries and socio-environmental pressure for the preservation of native vegetation (VERÍSSIMO; PEREIRA, 2014). Stricter supervision and the exchange of land use and occupation of native forest for grain crops, mainly corn and soybeans, also influenced the fall in the production of sawn wood non-coniferous tropical in Brazil during this period (DOMINGUES; BERMANN, 2012).

Despite the reduction in production presented by the historical series, Brazil's sawn wood sector moved more than US$240 million in 2018 (INTERNATIONAL TROPICAL TIMBER ORGANIZATION, 2020). The construction sector was the one that consumed the most sawn wood, used in works of residential and commercial

buildings, popular houses, bridges, viaducts, schools, and hospitals. The furniture industry is the second largest user absorbing not only sawn wood but also blocks and planks, sawmill residues, and plywood plates (ADEODATO et al., 2011).

To ensure wood demand and protect the environment, the Brazilian government maintains one of the most complete and rigorous environmental laws in the world (CHIAVANI; LOPES, 2017; BRUCH et al., 2019). The constancy of production from 2015 may be a reflection of the effort to contain deforestation in the Amazon Forest region. It may also be associated with low forest certification membership in Brazil (MCDERMOTT; IRLAND; PACHECO, 2015).

Approximately 91 million hectares of Indonesia were forest-covered and of this total, more than 65% were planted forest (ADI; MUHARAM; ADRIAN, 2017). Between 2000 and 2003, there was an increase in planted forests in the country due to greater internal investment in the sector (BRANN, 2002).

Indonesia experienced rapid economic and urban growth, which increased the country's carbon emissions (ZHU; SIMARMATA, 2015). To mitigate this problem, the government has pledged to reduce greenhouse gas emissions by 29% less than it would normally emit in 2030 (WIJAYA et al., 2017). Policies to reduce carbon emissions were generally related to forest preservation and restoration (ARYAPRATAMA; PAULIUK, 2019), which may be related to the steady production of sawn wood in Indonesia since 2004.

The steady growth in the production of sawn wood non-coniferous tropical in Vietnam was the result of the implementation of government policies aimed at restoring degraded forests. In 1995, the country joined the Association of Southeast Asian Nations (ASEAN). With the signing of the trade agreement with the U.S. in 2000, Vietnam focused efforts on international trade and began attracting foreign investment (IWANAGA et al., 2020).

Most of the country's sawn wood production was planted forests, mainly *Acacia* spp. and *Eucalyptus* spp. (BUI et al., 2005). Since 1996, timber exports have increased by 10 to 15% per year. The main products intended for export were furniture exported to Europe; sawn wood for Russia and Eastern Europe; and plywood, crafts, and timber in tarts for Japan, Taiwan, South Korea, and Hong Kong (HIEU, 2004).

Timber trade and the expansion of agricultural borders drove the exploitation of native forests in Thailand. However, after the major floods in 1989, the government

banned the exploitation of natural forests as a means of preventing other similar disasters, which explains the reduction in timber production between 1990 and 1997.

The country's domestic demand, mainly wood for civil construction and furniture industry, was supplied by areas of unpreserved native forest and by production forests, *Eucalyptus* spp. and *Tectona grandis* (NISKANEN, 1998; SHARP; NAKAGOSHI, 2006; BOULAY; TACCONI, 2012).

Across the world, the production of tropical non-coniferous sawn wood has decreased considerably. This can be attributed to the implementation of sustainable management in forests, which produces wood with reduced impact aiming at the protection of native vegetation (MOISEYEV et al., 2010); the decrease in wood demand in the construction sector due to the decline in population growth in European countries (HURMEKOSKI at al., 2015); and the replacement of sawn wood by Cross Laminated Timber (CLT) in civil construction (WIERUSZEWSKI; MAZELA, 2017).

From 2009 to 2018, the world production of CLT increased by 94.13%, demonstrating the shift of demand for sawn wood to glued wood (INTERNATIONAL TROPICAL TIMBER ORGANIZATION, 2020). The replacement of sawn wood by the CLT presents advantages such as the high level of prefabrication, reduction in construction time, low resistance/weight ratio, the possibility of multi-floor constructions, and good thermal and acoustic insulation. The product also contributes to sustainable development by being made of renewable material, with low production energy, and by promoting constructions with less waste generation (BRANDNER et al., 2016; ECKER et al., 2017; GOMES et al., 2019).

Export

Brazil showed an increase in exports of 70.97% from 2001 to 2004, and from 2004 by 78.06% until the end of the historical series (Figure 2). Between 1990 and 1994 there was an increase of 148.83% in exports.

Figure 2 – Historical series of the export of sawn wood non-coniferous tropical in a cubic meter of Brazil (BRA), Cameroon (CMR), Malaysia (MAS), and Thailand (THA) from 1990 to 2018. The x-axis is represented by the period, and the y-axis is the export data multiplied by a thousand.
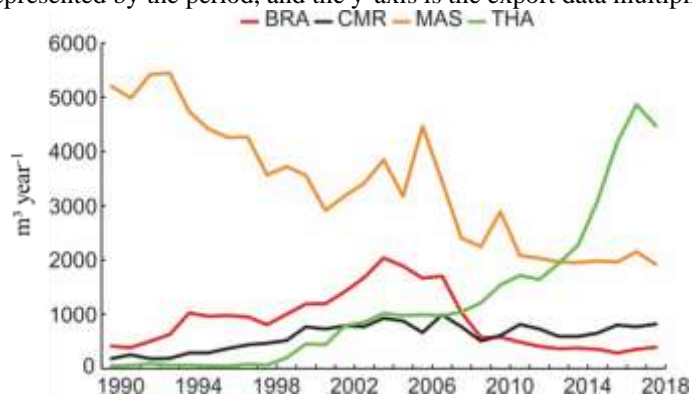
Cameroon showed growth in exports of 4 times comparing the values from 1990 to 2004. As of this year, there were oscillations with the peak in 2007 with an increase in production of 49.32% compared to the previous year (Figure 2). The volume of sawn wood exported by Cameroon is growing to a lesser extent when compared to market value, resulting in the appreciation of wood in the global market (Table 1).

Table 1 – Growth geometric rate, in percentage, for export sawn wood non-coniferous tropical from Brazil, Cameroon, Malaysia, and Thailand, between 1990 and 2018.

Country	GGR % (m³)	GGR % (US$)
Brazil	-2,39	-7,19
Cameroon	4,68	8,11
Malaysia	-3,84	-2,30
Thailand	19,70	14,90

Malaysia posted a 62.30% reduction in sawn timber exports throughout the historical series, with growth peaks compared to the previous year of 12.65%, 40.76%, and 28.60% in 2004, 2006, and 2010, respectively (Figure 2). Despite the wobbles, until 2013 Malaysia was the world's largest exporter of sawn wood. The volume of sawn wood exported by Malaysia shows growth in a smaller proportion when compared to market value, resulting in the appreciation of wood in the global market (Table 1).

The amount of sawn wood exported by Thailand was minimal until 1998. However, after that year, there was a growth of approximately 68 times until the end of the historical series (Figure 2). Thailand has thus become the world's largest exporter of tropical non-coniferous sawn wood. However, the product is losing market value (Table 1), because the volume of timber exported is growing in a greater proportion when

compared to the value of wood in the global market. The GGR in m³ is higher than the GGR in dollars (Table 1), indicating that the exported volume is increasing in a greater proportion than the value of the wood. Thus, the product is losing market value.

The increase in Brazilian exports between 1990 and 1994 was due to the reduction of import tariffs for processing machines. As a result, sawn wood production expanded due to technological improvements (MACQUEEN et al., 2003). Brazil directed its exports to Germany, China, Australia, Belgium, USA, due to the heating of the wood market in these countries. Also in this period, there was an easing of the exchange rate, resulting in the devaluation of the real against the dollar, boosting exports of sawn wood (NOCE et al., 2003). According to Santana et al. (2010), fluctuations in tropical sawn wood production have affected exports since 2004. Brazil's tropical sawn wood market was already degrouping before the global crisis of 2008.

Other factors have also influenced the reduction of exports, such as competitiveness in the global market (SOUZA et al., 2018), the 2008 economic crisis (SANTANA et al., 2010) which contributed to the downturn of the North American and European construction market (MACQUEEN et al., 2003), the high demand for sawn wood from the Brazilian domestic market (ALMEIDA et al., 2010), as well as the propensity of consumer markets to import only tropical timber of legal origin (SANTANA et al., 2010).

In 2017 and 2018, Brazilian exports increased by an average of 5% compared to 2016. According to the International Tropical Timber Organization (2019), in 2019, Brazilian exports of tropical sawn wood decreased 38% compared to 2018. As a whole, Brazil has lost space in the world scenario of tropical non-coniferous timber, despite the growth in 2017 and 2018.

The FLEGT Action Plan (Forest Law Enforcement, Governance, and Trade) implemented by the European Union (EU) influenced Cameroon's sawn wood exports. The main measure of this plan is to combat the extraction and illegal trade of tropical timber (ANDONG; ONGOLO, 2020; TEGEGNE et al., 2017).

In 2010 an agreement was signed between Cameroon and the EU which entered into force in 2011 (BRUSSELAERS; BUYSSE, 2018). However, since 1990 this country has committed itself to sustainable forest management, but only in 1994 was the first forestry law and inspection regulations adopted (ANDONG; ONGOLO, 2020). The selectivity of species for export was also one of the factors that implied the lower

participation of Cameroon when compared to other countries in the historical series (EBA'A ATYI et al., 2008).

Considering all countries that are part of ASEAN, Malaysia and Indonesia were the largest exporters of sawn wood to international markets (BUAINAIN; BATALHA, 2007). The reduction in exports of tropical non-coniferous sawn wood was a consequence of the decline in forest resources (PRETZSCH et al., 2020), as well as the implementation of sustainable forest management (ISLAM et al., 2010).

Thereat, Malaysia began to invest in exporting sawn wood furniture (HEEMMUDEN, 2016), with an upward trajectory since 2000 (NG; THIRUCHELVAM, 2012). If a country exports a primary product, such as sawn wood, it loses the difference between the value of the exported raw material and the value of the benefited product (e.g. furniture) that could be marketed internationally (NOCE et al., 2003). In this way, it becomes more advantageous to verticalize production.

The valorization and devaluation of wood in the world market may be associated with the international exchange rate system, global demand, production costs, raw materials, and labor related to each country (GAIO; MISKE, 2016).

Since 1989, the Thai government has banned native logging due to high deforestation rates and, as a whole, forest plantations have failed to supply the domestic timber market (NISKANEN, 1998). With the increasing forest implantation, the country began to stand out in the world market for sawn wood from plantations. Thailand exports approximately 65% of its production, with China being the main consumer of (HEEMMUDEN, 2016).

Most countries, except Thailand, showed a fall in sawn timber exports, the result of environmental preservation measures, taken over time. In Brazil, policy instruments were instituted to regulate exploration through sustainable forest management of public forests. There was an increase in inspection, resulting in the obligation to extract wood only from managed areas, aiming to reduce illegal deforestation. In addition to the growing incentive to reforestation and forest certification. The growing increase in exports of substitute products, such as sawn-off sawn wood, has also affected the tropical sawn wood market.

Import

Brazil has increased imports from the beginning of the historical series to 1996, with an accumulated increase of 50.90%. From that date, there is a sharp drop until 1999, with an export reduction of more than three times comparing values from 1996 to 1999. From 1999 to 2010, the import trend line has few fluctuations. From 2011 to 2018, imports do not exceed 45,000 m³ (Figure 3).

Figure 3 – Historical series of the import of tropical non-coniferous wood in a cubic meter of countries Brazil, (BRA), China (CHN), United States (USA), Thailand (THA), from 1990 to 2018. The x-axis is represented by the period, and the y-axis is the import data multiplied by a thousand.
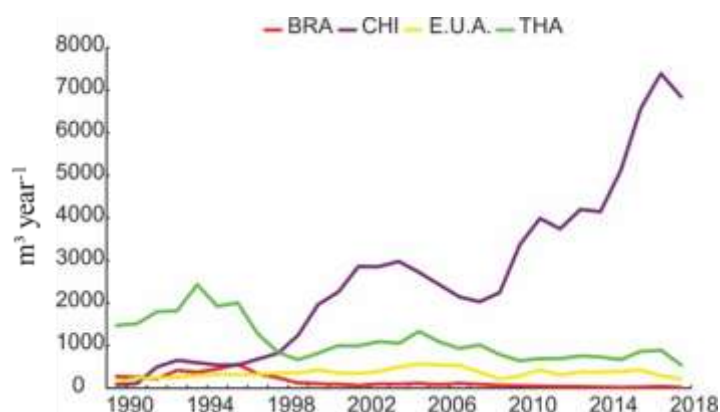
The TGC in dollars compared to the cubic meter, showing a gain in the market value of sawn wood imported by Brazil in the period considered (Table 2).

Table 2 - Growth geometric rate, in percentage, for imports of sawn wood non-coniferous tropical from Brazil, China, the United States, and Thailand, between 1990 and 2018.

Country	GGR % (m³)	GGR % (US$)
Brazil	-10,13	-6,80
China	12,91	17,83
United States	1,13	3,89
Thailand	-3,55	-3,91

China in 1990 had few significant imports. In 1992, imports tripled compared to the previous year. In all the years of the historical series considered, there was an increase in imports except for the period from 2004 to 2008, which showed a drop of 31.85%. From 2010 to 2016, there was the highest growth in imports, observing that the volume imported from wood doubled in this period (Figure 3). China presents the GGR in dollars

higher than that in cubic meters (Table 2), indicating that imported wood had gained in market value.

The United States showed growth in imports from the beginning of the historical series to 2002, with a cumulative of 129.38%. In 2005, the value of imports was the highest in the historical series analyzed, with an increase of 66.27% between 2002 and 2005, corroborating the studies of Daniels (2008). From 2005 to 2009 there was a 62.36% drop in imports and from 2011 to 2016, they remained stable, with small fluctuations (Figure 3). Wood imported by the United States has gained market value during the historical series considered (Table 2).

Thailand had a relative consistency in imports until 1996. From that year on, imports decreased by 66.68% considering the values between 1990 and 1996. Thereafter, imports increased again by 99.84% in the accumulated period until 2005, and decreased by 51.99% in the period from 2005 to 2010, remaining with small fluctuations until 2018 (Figure 3). The value of the GGR in cubic meters was higher than the GGR in dollars, indicating that imported wood was losing market value in the period of the historical series considered (Table 2).

As Brazil was one of the largest wood producers and most of its production was absorbed by the domestic market, imports are little significant in the Brazilian market (IBÁ, 2019; INTERNATIONAL TROPICAL TIMBER ORGANIZATION, 2019).

China was one of the largest importers and exporters of wood-based products in the world. Although almost a fifth of the country is covered by forests, one-third of which is planted, China cannot supply its wood demand, and it is necessary to import the product (WELLESLEY, 2014). With China's entry into the World Trade Organization at the end of 2001, coupled with growing demand for interior furniture and wood, Chinese imports of timber products have increased significantly (SUN et al., 2004). In 2005, the demand for all timber products from China was 280 million m³.

To meet this demand, the country has depreciated the tariff rates for imports of wood, with a reduction of up to 5%, as a way to increase imports (VALVERDE et al., 2005).

The United States is the world's largest wood consumer and domestic timber production in the country was not enough to meet the demand, especially from construction. The import of sawn wood was sensitive to the real estate market, and the

recession periods of the sector were coincident with falls in imports (MCKEEVER; HOWARD, 2011).

In the early 1990s, Thailand's economy was thriving. With the Asian financial crisis from 1997 to 1998, there was a devaluation of the local currency against the dollar and the deficit in the government's public accounts generated a lack of confidence from foreign investors, leading to the mass outflow of capital. All sectors were impacted by the crisis. Growth slowed down, decreasing demand and consequently sawn wood imports (HOPKINS, 2006).

In 2018, in general, there was a fall in imports of sawn wood non-coniferous tropical worldwide. The slowdown in the economy has reduced demand from major importers such as China, the United States, and Thailand (INTERNATIONAL TROPICAL TIMBER ORGANIZATION, 2019).

The sawn wood non-coniferous tropical from all the countries analyzed had a gain in its market value (Table 2), considering the 28 years of the historical series analyzed, except for Thailand. Relating the production data with the import data, it can be seen that the reduction in the production of the most representative countries in the market provided the appreciation of the market price of sawn wood, because the demand remained constant, except for China, which increased the exports. As Thailand was an expressive producer of sawn wood, prices are more competitive, being a possible cause of the loss of the market value of sawn wood.

The requirement for certification of imported products increased investments in sustainable management and the regularization of labor and environmental legislation, significantly increasing the production costs of sawn wood. However, consumer countries are willing to pay for a product that has all legal compliance, whether environmental, labor, or tax (CARNEIRO et al., 2013; SILVA et al., 2016).

CONCLUSION.

The production of sawn wood from tropical non-coniferous species decreased in all countries studied, due to the replacement of wood by other products, environmental pressure to protect native forests, and the economic slowdown.

Brazil, Malaysia, and Indonesia showed a drop in sawn wood exports. Thailand shows a growing trend due to low domestic demand and a large number of forests in the country.

The three largest wood-importing countries as of 2010 show a trend towards stability in the import of tropical non-coniferous sawn wood, except for China, which, due to its exponential economic development, shows a growing trend in the entire historical series.

ACKNOWLEDGMENTS

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