

PRODUCTION AND MARKET OF TIMBER HOUSING IN BRAZIL

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Abstract:

This paper aimed to analyse timber houses produced in Brazil, identifying the main market locations. In this unprecedented insight, an interview survey was carried out by a semi-structured questionnaire applied on respective producers. First question was developed to estimate quantitatively the annual Brazilian production of timber houses for a triennium. The second question delimited the market extension regarding the main destinations of produced houses. Face-to-face interviews were used to collect data with house producers. Margin of error was calculated to validate sampling process and respective results. A wide respondent amount about 51% of this sector, and the consideration of six different local states were main strategies to confer validity and reliability of the sampling process. From 12,000 to 20,000 timber houses were annually produced in Brazil during this triennium, showing an increase from 0.32 to 0.52% per year. Brazilian timber housing market prioritizes three extensions: local, state and regional (neighbouring states). Compared to European countries, Brazilian production volumes have been representative, although masonry residences still prevail in the domestic market. Leading domestic markets are located in higher concentration zones of producers in the Southern and Southeastern states, for example, Santa Catarina, Rio Grande do Sul, Paraná, São Paulo, and Minas Gerais. Many producers have commercialized nationwide, reflecting in the greater visibility for timber houses. Despite lower export levels, African and European continents symbolize the main destinations for timber houses produced in Brazil. Both internally and externally, market potential of timber housing is further promising for this respective production sector in Brazil.

Key words: production; market; timber houses; construction; sectorial research; interview.

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INTRODUCTION

Housing market has fundamental importance for people living in urban centres. In developing nations, house production plays a key role in economic development, as the sector intensely absorbs unskilled workers (Lucena 1981). The promotion of subsidized housing could provide a prompt impact on labour hiring and market growth of the Brazilian construction sector (Brazil 2017). De Araujo *et al.* (2016c) stated that strong industrialization of timber houses with prefabrication of parts should be the center of attention in the near future, bearing in the mind the housing shortages in many developing and underdeveloped nations. Also in Sweden, timber buildings are a viable option to support the effort minimizing its local housing shortage (Lindblad *et al.* 2017). It is relevant to mention that prefabrication is not recent, as there is evidence dating back to 1624 in England (Arieff and Burkhardt 2002), being visible on the Brazilian sawmills since the 20th Century (Zani 2013). However, timber housing is not so widespread in Brazil, whose market is dominated by masonry. Hence, there is a demand to verify the timber housing production in Brazil, defining the main markets and volume of produced constructions.

Timber housing in Brazil and available public information

The last general scenario of construction techniques in Brazil was evaluated in 2010, by the Brazilian Institute of Geography and Statistics (IBGE). This governmental agency produced a census that categorized the main construction housing for each municipality, according to the main prominent material applied for walls. In this demographic census, IBGE (2010, 2012) identified the construction materials with highest prevalence in Brazil: masonry (with and without wall coating), wattle and daub (with and without wall coating), machined timber (sawn wood and composites), straw (leaves, bushes, barks, thatch *etc.*), reused wood (packaging, scaffolding, casts for concrete *etc.*), other raw materials (plastic, zinc, steel *etc.*), and wall absence (indigenous structures with wood poles). According to IBGE (2013), a sharp fall in the presence of “pure” wood-built houses from the South and Center-West regions, a slight decrease in the Northern states as well as a general increase of mixed houses based on wood and masonry were noted between 1991 to 2010.

Despite its potential, timber is still underutilized in the professional practices (Patlakas 2015). This cultural barrier has also occurred in the Brazilian construction industry, restricting timber house expansion. Shimbo and Ino (1997) stated that low use of reforested wood in subsidized social housing is due to knowledge of its potentials and low acceptance by users and owners.

Great uncertainties regarding timber constructions could be noted by the IBGE (2010, 2013) sampling of dwellings located in Brazil. This local demographic census was based, generically and exclusively, on the building materials with greater predominance in external walls of the houses. In light of this, regarding construction techniques, half-timbered frame houses – very popular in the Brazilian Southern region – could have been mistakenly identified as masonry dwellings, because according to Kniffen and Glassie (1966) and De Araujo *et al.* (2016b), such technique refers to a timber house and their external and internal walls demonstrate a predominance of brick masonry. This fact is possible because timber-based skeleton of a half-timber frame technique serves only as a structural support for this building model. In addition, poor identifications on the part of census taker, on building characteristics, it might be possible because of: owners and/or users do not share or declare the raw material used in walls and structures; census taker do not verify and/or confirm the raw materials applied in the wall by owner asking or wall touch; and, lack of knowledge regarding different building techniques by census taker, especially, about timber-based housing. For example, woodframe houses (balloon, platform, mixed or modular) could be erroneously identified as masonry residences, due to a similarity in the external surface finishing of walls. Anderson (2002), Burrow (2014) and De Araujo *et al.* (2016a) verified that woodframe houses could present different external wall coverings such as timber, aluminum, vinyl, masonry, gypsum, cement, and fibrocement board.

Woodframe technique also allows the application of gypsum, slabs, plaster, roughcast, stucco, and mortar in the walls – whose materials are characteristics of the masonry construction, according to IBGE (2012). Therefore, this mistake could occur in reason of the no exposure of internal structural elements formed by lumber skeleton (frame) and wooden composite panels (internal sealing).

This problem of identification could still be present in clapboard and wainscot houses, very popular at the Paraná state and Southern region of São Paulo state. Batista (2011) stated that there is a timber house negation due to pure prejudice on the part of Brazilians who longed for masonry houses and, for that reason, many houses based on clapboard and wainscot technique were coated by mineralized wooden panels; this palliative provided an external wall finishing similar to masonry. Also, other uncertainty regarding to methodology used by IBGE (2010, 2013) revealed differentiation absence of between several timber housing techniques commercialized worldwide, which were widely identified by Piqué Del Pozo (1984), Morgado *et al.* (2012), De Araujo *et al.* (2016b), and others.

Concentration of this data only on a single category – named by the aforementioned IBGE’s census as houses based on machined timber – interferes in a precise understanding about this information, particularly

from side view of the popularity of timber housing techniques. However, the existence of this data can reveal timber houses participation in Brazil, even in a comprehensive and generic perspective. In view of these possible mistakes and by means of this demographic census in 2010 from IBGE (2013), two considerations were made: several timber houses could easily have been identified as masonry residences, which would imply a housing number larger than that informed; in detail, this census did not specify timber construction techniques used in each evaluated dwelling. Thus, genuine amount of houses predominantly based on wood situated in Brazil could be larger than 3.68 million as stated by IBGE (2010). Residences based on machined timber are predominantly made in industrial configuration, while houses based on reused wood are produced with packaging, scaffolding, siding, among other residual materials (IBGE 2010, 2013); versions with reused wood are represented by simpler homeless shelters or homes for needy people.

Wattle-and-daub houses and indigenous homes without walls also apply wood as structural material (IBGE 2013), which are identified as vernacular timber houses by De Araujo *et al.* (2016b).

Regarding predominant wall material from Brazilian dwellings, IBGE (2010, 2013) indicated that about 52 million (90.68%) are made with masonry (with and without coating), 3.7 million (6.24%) with wood, 900000 (1.56%) are based on mud/soil (with and without coating), 53000 (0.09%) in straw, 1700 (0.003%) are indigenous solutions, and 230000 (0.40%) are built with other materials. The same document informed that about 480000 (0.84%) constructions were considered as sub-dwellings, due to reutilization of wooden parts classified as building waste.

High construction costs have been a major concern for potential customers in the construction industry (Baloi 2012). Although housing construction sectors – popularly based on wood – from North America and Europe indicate improvement signs, they are still at a stage of complete recovery from the global financial crisis of the 2000s (Palacín 2015). As building material for subsidized housing production, wood from planted forests could be identified as an important alternative, particularly, in context of sustainable development, which can be defined as continuous improving process of people's living conditions, especially in developing countries (Shimbo and Ino 1997). Among the main construction materials (wood, steel, masonry, and concrete), a comparative research developed by Kuzman *et al.* (2010) suggested that timber houses are the most convenient solutions for residential purposes, especially due to criteria of quality, fire safety, energy efficiency, and aesthetics.

In Brazil, more advanced techniques under technological aspects (for example, woodframe and modular houses) have greater possibility of market at industrial large-scale. Despite the lower rationalization of material utilization, some housing techniques could achieve efficient industrialization levels such as prefabricates based on clapboard and wainscot, nailed clapboards, log-homes *etc.*

OBJECTIVE

Due to these difficulties in identification of timber housing in Brazil, and their uncertain amount revealed by local IBGE's census, this study aimed to characterize, with local producers, the volume of timber houses produced during 2013, 2014 and 2015, identifying respective main markets. The following hypotheses were pointed out: annual production of timber houses exceeds 6,000 units in Brazil; and, the main sectoral market focus is based on product trade at national levels.

METHOD

Principle of the study, main focus and materials

This paper is part from a broad research about Brazilian timber housing production sector developed by De Araujo (2017), whose focuses were identifying characteristics, evaluating aspects, listing hindrances, and measuring potentialities about production sizes, volumes, amounts *etc.*

Main reason to carry out whole study was related to absence of detailed data about this timber housing sector, which is little-known industry from civil construction. Furthermore, lack of specific associations has contributed to unclear situation and undefined characteristics. In the light of this chronic situation, such main research included the performance of an interview survey based on mixed focus, due to its great amount of studied perspectives. Due to these different observed perspectives and their large data amount, face-to-face interview process was the main and best way to carry out this survey, through a standardized questionnaire to be applied for entrepreneurs from this particular sector, due to their knowledge and experience concerning industrial characteristics.

Similar to the methodology performed by the aforementioned author, this paper considered the use of the following materials: timber housing producers, bibliographic material (scientific, technical, and governmental documents and data), and standard questionnaire to register the data collection from sampled companies.

Sectoral population and sampling

Due to the data absence about timber housing production sector and its characteristics, the producer definition was a hard trouble to be initially solved. This strategy was detailed by De Araujo *et al.* (2018 a,b,c, 2019) to delimit this sectoral population and serve as reference for methodology route considered here. Through searching on internet, a former listing of producers was formulated by the project manager, which was constantly updated after identification of each timber housing producer. This final listing enabled the performance of interview survey, providing data on sectorial market and production. Then, the sampling process could be started from this essential information, that is, the company listing. This listing revealed that around 92% of timber housing producers are concentrated in six states: São Paulo, Minas Gerais, Paraná, Santa Catarina, Rio Grande do Sul, and Distrito Federal. For that reason, these Brazilian states were selected as study area in this research, in reason of cost displacement to performance of in loco interviews. Moreover, all timber house producers from these states were initially contacted by phone to interview scheduling. But, only part of this public was motivated to participate on this survey research, generating random responses.

Questionnaire aspects and formulation

A small committee was formed to carry out all surveying lineations and processes. This team was formed by professionals from industry and university focused on timber construction, whose group was responsible for every questionnaire stage – this procedure involved preparation, detailing, correction, pre-test, and definitive consolidation of questionnaire to be applied for Brazilian timber housing producers. Face-to-face interviews were only carried out by the project manager (first author).

Queries for questionnaire and respective considerations

Semi-structured interviews were considered to collect data on person with the interviewees. Two questions were studied to enable an understanding in relation to their annual volume of produced timber houses and respective main markets. First observed query was: “which timber house quantity was yearly produced by your company in 2013, 2014 and 2015 periods?”. This quantitative question based on open and free answers allowed to determine volumes of timber houses produced per year in each company. This query was established to promote detailed annual production of timber buildings, considering that this numerical information has been unavailable in the Brazilian scenario. This situation could be attributed to local construction industry due to devaluation of such timber-based housing technique faced by traditional masonry houses, resulting in this cited lacking. Due to the difficulty to detail the production volume in fractions by house technique, this study considered the total amount regardless of the housing variety (technique). This strategy aimed to refine the data collection, reducing interview times and studied variables. This consideration also allowed the calculation of the standard deviation, since a subdivision per housing technique would limit the sampling, stratifying the total number of repeats (sampled entrepreneurs) into small fractions for each different technique made with wooden materials.

Three projections about general volume of timber houses produced in Brazil were estimated by average, minimum and maximum annual values. Average projection for whole industry was obtained by proportionality among house volume produced by sampled companies, sampled company amount, and total population of studied sector. Maximum and minimum projections were respectively the lowest and highest variance values, according to margin of error from this survey.

For this analysis, some literature concepts were considered. Campagner (2005) pointed out that a relationship between magnitudes (length, time, quantity *etc.*) can be easily solved by cross multiplications between proportions. Silva (2013a) inquired that the method of proportionality acts as functional relationship between magnitudes. According to Silva and Guerra (2011), this principle consists in linear functions that correlate to financial mathematics, percentages, and others.

Then, due to short evaluated period for data collection, that is, from 2013 to 2015, it was not possible to find specific and effective mathematical model to determine total volume of timber houses produced by related production sector. Despite this limitation, proportionality principle emerged as a timely alternative to estimate total Brazilian production of timber houses for this short period. Thereby, through ratio between sampled and all sector producers in relation to sampled volume of housing units produced per year, a total estimation of timber housing produced in Brazil was possible. Such strategy could serve as guiding value for each studied period, whereas this data is not locally available.

Second query was: “what were main markets of timber houses produced by your company?”. From closed character, five qualitative responses were indicated to designate the market range: local (including neighboring cities); state; regional (including neighboring states); national; and international. In affirmative answers, each interviewee was encouraged to declare nominally the house destinations.

Despite existence of timber housing amount per Brazilian state, declared by IBGE (2010, 2013) on its demographic census, there is no information concerning its annual production as well as its market focus

specifications. This approach will be important for forest-timber and construction chain strategies, because outcomes and discussions could reveal production destination possibilities from national and/or international perspectives.

Statistical analysis

Triangulation was doubly considered to certify and confer every obtained result. Sampling amplitude involved the inclusion of the same six Brazilian states from three regions in data collection. Sampled interviewees represented larger percentage from the whole sector, despite the performance of costly method of face-to-face interviews. Simultaneously, first question considered the observation in three years, also enabling annual comparisons. In the second question, qualitative responses were converted to quantitative responses, that is, for percentage values, to allow comparative response. After listing with producer amount and data collection from sampled interviews, the margin of error was calculated to statistically validate this survey. This procedure was supported by Raosoft Sample Size Calculator (Raosoft 2004), following those software's prescriptions to the letter: confidence level of 95% and response distribution of 50%.

RESULTS & DISCUSSION

Timber housing population estimation and survey

About 51% of whole sectoral population was considered here (Table 1), and six states were included (Rio Grande do Sul, Paraná, Santa Catarina, Minas Gerais, São Paulo and Distrito Federal), which provided reliability and validity for sampling process, despite the high costs of face-to-face interviews. Thereby, the margin of error of $\pm 3.325\%$ classified this research sampling (Table 1) – using Pinheiro *et al.* (2011) prescriptions – within the acceptable (10%) and closer to ideal level (5%). This survey showed efficient performance, whose evaluation sampled more than 50% of the studied sector.

This sampling did not identify the amounts of timber houses traded by technique (Table 1), in reason of the complexity of displacements among the sampled companies as well as the entrepreneur availability. These reasons were related to the fact that 54.21% of studied producers commercialize more than a housing technique. Also, this stratification would also delay the interview process.

Table 1

Data of Brazilian producers of timber houses.

Result	Producer (Unit)	Margin of Error (%)
Total of Estimated Population	210	–
Amount of Interviewed Companies	107	6.65

Sources: De Araujo *et al.* (2018a,b,c, 2019)

First question: production of timber housing in Brazil

Without changes in the analysis methodology, the precise identification of sales volume from houses by technique would be possible solely in a situation (Table 2): for those producers focused only on a housing technique. However, this consideration would reduce sampling reliability (Table 1) as well as it would restrict the standard deviation for those construction techniques with few available producers in front of the whole sector, for example, one or two companies.

Thus, the volume of timber housing produced by sampled companies included only total sale values per company and for each observed year (Table 2). This table showed average and overall median of housing units produced per company, and total number of house made by 107 sampled producers (Table 1). General sectoral projections were obtained by the proportionality among housing production from sampling (Table 2), company sampling and general sectoral producers (Table 1).

Brazilian timber housing sector produced between 17000 and 19000 houses in 2013, 18000 to 20000 in 2014, and 11000 to 12000 in 2015. A sharp decreasing in 2015 (Table 2) could be attributed to, according to Freitas (2016), severe crisis that discouraged the Brazilian estate market.

In Lithuania, an important European producer, about 1500 timber houses were produced in 2007 with 75% of this amount directed for exportation (MNGA 2008). In 2016, 52705 timber houses were built in the United Kingdom countries, revealing a 2% increase over the previous year (Egan Consulting 2017); even in unfavorable economic moments, Brazil has showed a relevant production (Table 2), suggesting an outstanding potential industry with capacity to supply domestic and foreign markets. Next to forest and timber potentials, Brazil could easily expand its timber housing production.

Table 2

Brazilian timber housing production estimative from evaluated sampling (n = 107).

Number of Timber Houses Produced in Brazil	Studied Annual Period (in House Units)		
	2013	2014	2015
Median by Producer	29	25	21
Average by Producer	88	91	57
Production from Sampling (107 Producers)	9366	9740	6099
Standard Deviation for Survey Sampling	249.17	239.70	130.22
Average Sectorial Projection (210 Producers)	18382	19116	11970
Minimum Sectorial Projection (-3.325%)	17771	18480	11572
Maximum Sectorial Projection (+3.325%)	18993	19751	12368

From those 3.68 million of timber housing situated in Brazil (IBGE 2010), and estimated total average projections for these dwellings annually produced (Table 2), it was verified that Brazil has an annual housing growth between +0.32 and +0.52% in the worst (2015 period) and the best (2014) scenarios, respectively. This increasing would contribute to maintenance of timber houses existence, since these solutions exceed 6% of the Brazilian residences according to IBGE (2010, 2013). Such market is similar to the English panorama in early 2010s, since “timber housing was the second most popular alternative with about 7% of market share in England” according to Hamilton-MacLaren *et al.* (2013). This contribution is relatively low in view of its demand for more sustainable low-cost housing (Omorieg and English 2017). In comparison, wood has contributed strongly to lightweight building markets in the North America and Northern Europe (Perstorper *et al.* 1995) as well as has stimulated market growth for timber buildings in the United Kingdom (Moore 2015).

Egan Consulting (2017) defined that timber frame housing share in the United Kingdom rose again to almost 29%, whereas Scotland share rose was around 83%, followed by Wales with almost 31%, England (23%), and Northern Ireland (17%). In general, there are about 27 million homes in England (Palmer and Cooper 2014), among which almost 23% are mostly based on timber material (Egan Consulting 2017) – in this case, England could concentrate about 6.15 million of timber houses.

In a parallel way, through the estimated annual housing growths around of 0.32% and 0.52%, as well as 3.68 million timber houses in 2010 according to IBGE (2010), Brazil has between 3.76 and 3.82 million today. While England has tripled its timber housing market share in less than a decade according to the projections from Hamilton-MacLaren *et al.* (2013) and Egan Consulting (2017), Brazil revealed a slight increase between 2.21% and 3.57% (Table 2), raising its market share to 6.6% and 6.7% in the worst and the best scenarios, respectively. This contrast also reinforces need for modern public policies to intensify the wood utilization on Brazilian construction, since this nation has large forest areas. Nevertheless, Buongiorno and Zhu (2014) stated that “Brazil has planted forests in only 1% of its own total forested area”, which reveals its huge potential as silvicultural supplier of wood for construction. This strategy could assist in local housing shortage, whose estimation is, according to FIESP (2016), about 6.2 million households.

Second question: market of Brazilian timber houses

In this survey, it was not possible to track sales volumes according to their market destination and to houses sold by construction technique, due to difficulties from sampled companies to inform this data in short term for interviewing performance. In addition, uncertainty surroundings about the final destination of timber house production also affected those producers with expertise in disassembled kits, because these prefabricated timber houses are sold nationally in two ways: direct, with commercialization to customers and authorized representatives; and indirect, whose activity does not involve official partners or representations.

In the exportation of timber houses, this uncertainty could be even greater concerning quantity of marketed products for each nation – because most of studied producers do not have foreign official partners or representations, encouraging them in marketing through trading offices and middlemen – similar to other industrial activities. These independent and intermediate agents concentrate on timber housing sales to other foreign partners and/or companies, interfering on product tracking.

Fig. 1 showed commercial extent from timber houses produced in Brazil. Market evaluation was considered to understand its comprehensiveness. This part was focused on the determination of national and international markets, respectively showed in Figs 2 and 3, to which these producers sold products during 2013 to 2015 years. All studied companies commercialized timber houses in local context (Fig. 1), that is, including headquarters location of each producer and other neighbouring municipalities and cities. Similarly, this scenario almost was repeated at state level.

Regional coverage, which included state of origin of each company and some neighbouring and/or nearby states also presented a high percentage, above 60% of producers, $\pm 3.325\%$ according to obtained margin of error. High regional percentage shows that many companies are prepared to produce timber

houses for a public farther from their headquarters, which reinforces the fact that these ones concentrate larger industrial sizes to serve more distant customers. More than 35% ($\pm 3.325\%$) of sampling also commercialized their products for whole Brazilian territory. This perceptible share showed that around 1/3 of these producers presented consolidated industrial infrastructure to supply market from very distant localities (Fig. 1).

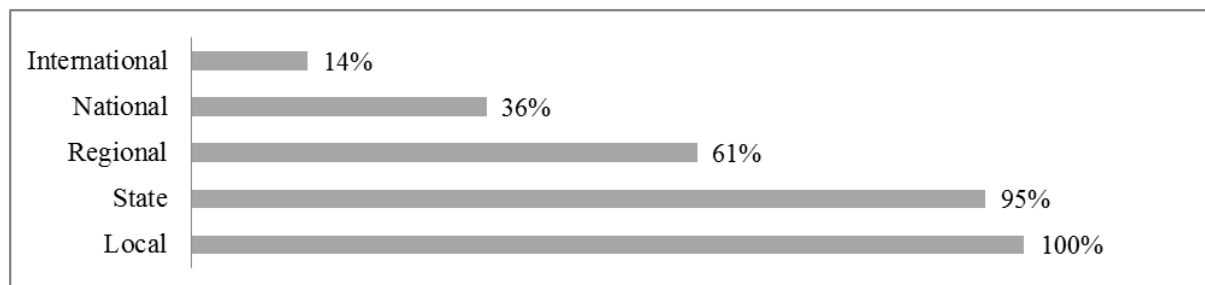


Fig. 1.
Market popularity from Brazilian timber housing producers (n = 107).

About state markets, Santa Catarina state concentrates the largest number of timber housing producers in Brazil and, therefore, also has the largest market presence of these products, with almost 75% ($\pm 3.325\%$) of companies (Fig. 2). Considering the margin of error, Rio Grande do Sul, São Paulo, Paraná and Minas Gerais were also available in, at least, half of the sampled companies. This factor was justified by industrial consistency and greater producer presence in these Brazilian states. Good popularity in the Mato Grosso do Sul (Fig. 2) is greatly benefited due to its geographical proximity to region with largest market and based on these cited five states. However, this Midwest state does not have any active producer. Lastly, those remaining 20 Brazilian states were market for 1/3 of evaluated sampling, since many producers declared to serve whole territory (Figs 1 and 2).

Comparing to prefabricated timber housing sector, Punhagui (2014) declared that São Paulo concentrated 57% of the national market, followed by Santa Catarina (33%), Rio de Janeiro (29%), Paraná and Minas Gerais (19% each), Rio Grande do Sul (14%), Distrito Federal (10%), Goiás (5%) and whole country (14%). Despite the result similarity with Punhagui's study for São Paulo state, other market shares were different, possibly, due to the restricted side view considered by this author.

Around 15% of these companies already distribute their products to international markets, identifying importance and interesting potential of this sector for Brazilian trade balance (Figure 1). While Estonia positions its industry as European leader, exporting from 80 to 90% of all timber houses (Eesti Puitmajaliit 2009), Lithuania has directed about 75% of its production to other countries (MNGA 2008). Despite a noticeable external market, Brazil still perishes in comparison to these nations.

In this evaluation (Fig. 3), African countries are the main destinations of timber houses exported by Brazilian producers, followed by the markets in Europe, and South and Central Americas, which concentrate participations between 5 and 10% ($\pm 3.325\%$). Moreover, Asian and North American markets were around 4%, and the Oceania had a market below 2%.

Comparing to another scenario, the Lithuanian market exportation is exclusively focused on Scandinavian and Western European nations (MNGA 2008). Thereby, every Brazilian producer could explore better this product export for Europe, mirroring in this commercial strategy from Lithuania.

In a world of finite resources, timber and engineered timber products offer the opportunity to build houses in a much more sustainable manner (Dickson and Parker 2015). For coming years, Brazil expects a growth in local construction sector and its consequent job creation, with implementation of new measures to expand people served by low-cost public housing financing programs (Brazil 2017). This program access is still restricted for all timber housing producers, due to scarce representation of this sector in local housing programs, and some persistent rejections about these houses. Shimbo and Ino (1997) have attributed these rejections to government leaders, entrepreneurs, and population.

Facing different construction types (masonry, concrete, steelframe etc.), timber-based houses have been considered as the most suitable options for residential building, since they are produced with natural material as well as provide good energy efficiency and structural properties (Kuzman and Grošelj 2012). Timber solutions have been found as secular vernacular constructions, being usual and useful for countries with harsh winter climate (Bartha 2018). Regarding benefits, Franzini *et al.* (2018) also suggested rapid construction and utilization of local renewable materials to support industry.

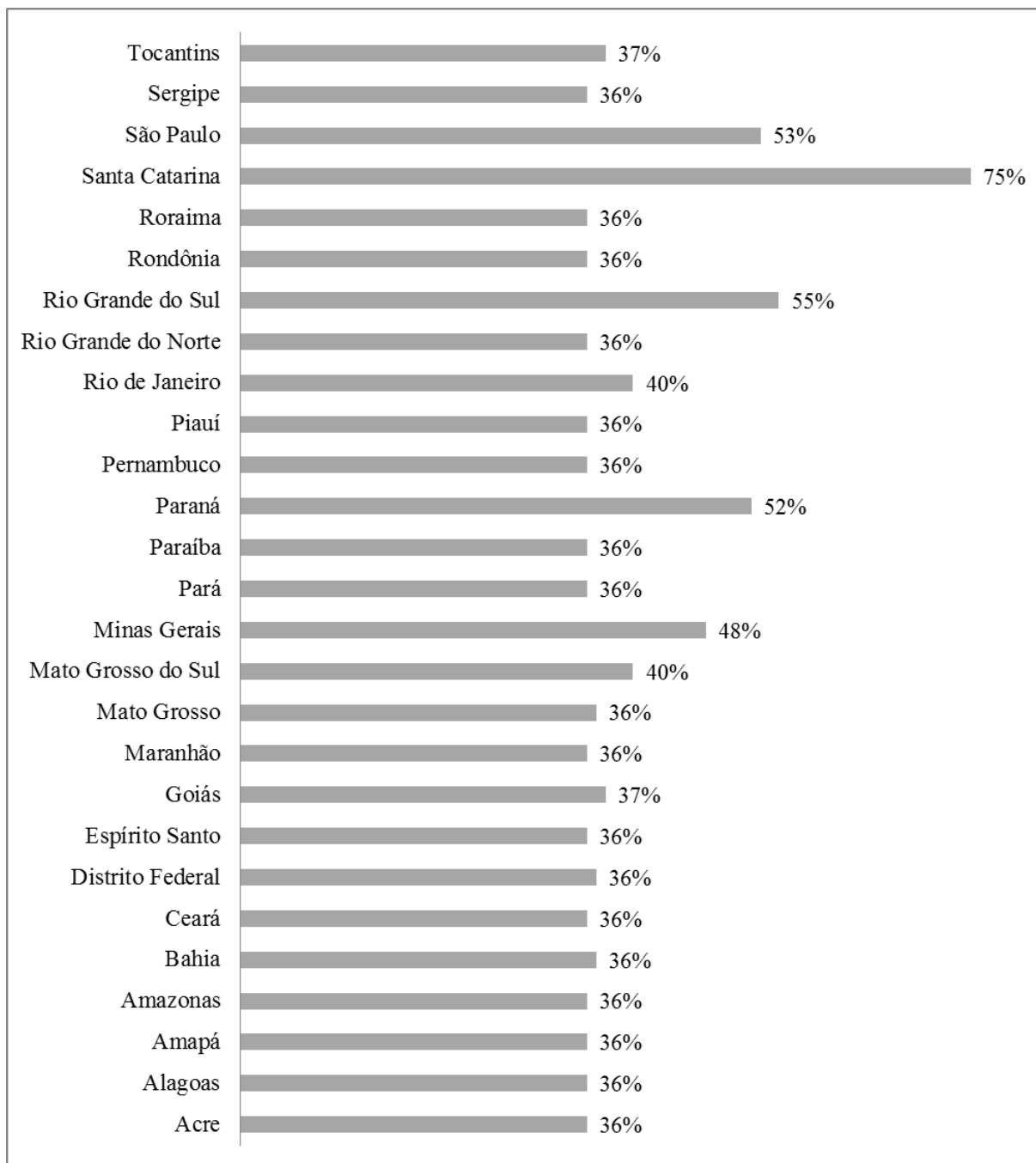


Fig. 2.
State market popularity from Brazilian timber housing producers (n = 107).

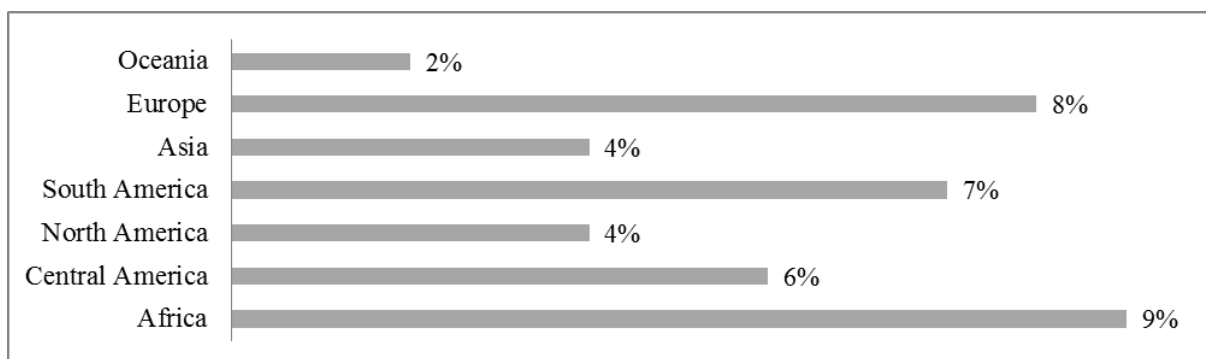


Fig. 3.
International market popularity from Brazilian timber housing producers (n = 107).

An advantage clarification of timber residences becomes essential to its expansion in Brazilian market, whose local presence is dated from the late 1800s according to Zani (2013). Timely strategies could accelerate the market expansion. To encourage future timber housing acquisitions, De Araujo *et al.* (2016c) suggested a media disclosure with emphasis on its advantages as well as the consumption of timber houses by famous artists. According to Schmelzenbart *et al.* (2018), improvement of cost-performance relations and environmental issues could encourage the market development of lignin-based products. Brazil could be inspired by the Swedish experience – there, Lindblad and Schauerte (2017) realized a greater competitiveness for relatively conservative strategy, whose features include companies producing wood-based single-family houses with low-cost development approach.

CONCLUSIONS

Despite the supremacy of masonry technique in Brazil, timber houses have prevailed as the second most consumed category in the overall domestic construction market. Brazilian market share is perceptible and could increase in the coming years, encouraging a whole forestry chain. This annual production of timber houses remained stable in 2013 and 2014, despite a national crisis experienced in 2015, which slightly decreased this produced volume. From foregoing, timber housing production has been representative in Brazil. This annual volume already typifies a quarter of the scenario in the United Kingdom, above all, formed by Scotland, England, Northern Ireland, and Wales. Despite the greater Scottish relevance in this topic, timber housing markets would be similar in Brazil and England.

With respect to commercialization regions of timber houses, Brazilian market turns to local, state, and regional scenarios, especially, in areas with more industrial and producer concentration, for example, Southern and Southeastern states, and its respective surroundings. Most of companies has commercialized throughout Brazilian territory, revealing a good structural condition to serve farthest regions from their origins. Simultaneously, a certain percentage of this sector has already contributed with local trade balance, whereas this small group has exported timber houses to other countries.

In short, Brazilian panorama of timber housing sector could generate greater market potential for the next future, especially, about the mitigation of local housing deficit. Also, further studies are suggested to approach quantification of timber houses commercialized by technique for larger annual periods, above all, within a similar or lesser margin of error. This strategy would allow formulation of models to predict, with greater fidelity, timber housing production in Brazil to that studied period.

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