International Journal of
Advanced Research in Social Engineering and Development Strategies
ISSN Print: 2315-8379 ISSN Online: 2354-161X Vol. 4, No. 1 January, 2016

# Wood Density of Rubber (*Hevea Brasiliensis*) Grown in South-Eastern Nigeria for Utilization Purposes

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Abstract
The aim of this work was to determine the wood density of rubber wood (Hevea brasiliensis), one of the least studied non-commercial wood species in terms of wood utilization. Wood density indicates the amount of actual wood substance present in a unit volume of wood. Wood density is not a simple characteristic; It is affected by the cell wall thickness, the cell diameter, the early wood to latewood ratio and the chemical content of the wood.Wood density is an important wood property for both solid wood and fibre products in both conifers and it is a general indicator of cell size and was a good predictor of strength, stiffness, ease of drying, machining, hardness and various paper making properties. Basic density is closely related to end-use quality parameters such as pulp yield and structural timber strength However, wood samples of Hevea brasiliensis were collected from a rubber plantation in Michael Okpara University of agriculture Umudike and standard test methods were followed on small green specimens. . The mean values of the wood density along the bole of Hevea brasiliensis at 45%, 65% and 75% levels of total height which gave the base, middle and top respectively were given that the top of tree 2 which was at the 75% level had the highest density of 562.50kg/$m^3$, followed by its base at 45% level, which had a density of 542.50kg/$m^3$. The middle of tree 1 which was at 65% level of total height had a density of 533.83kg/$m^3$, while the base of tree 3 had the lowest density of 395.0kg/$m^3$. The average of the within rubber tree ranges from 494.83 ± 14.19 to 489.60 ± 20.13 kg/$m^3$. The main statistical tools used were descriptive statistics and one-way analysis of variance (ANOVA). Hevea brasiliensis wood is in the “medium” grade. It compared favourably with known species such as Aningeria altissima, Terminaria ivorensis, and Antiaris toxicaria in several properties and strength which are suitable for furniture production. This study has shown clearly that Hevea brasiliensis can be a good source of raw material for the wood products industry.

Keywords: Wood, Rubberwood, Density, Hevea Brasiliensis,

http://internationalpolicybrief.org/journals/science-publishing-corporation-journals/social-engr-and-dev-vol4-no1-january-2016

## Background to the Study

*Hevea brasiliensis* is of the family Euphorbiaceae and it is a fast-growing tree, rarely exceeding 25cm in height, but wild trees of over 40m have been recorded. The bole is usually straight or tapered, branchless for 10m or more, up to at least 50cm in diameter, without buttress, bark surface is smooth, hoop marked, and grey to pale brown (Peel, 1958).

*Hevea brasiliensis* is a hardwood from the Maple family of hardwoods and has very little tendency to warp or crack, it is eco-friendly and is often the most misunderstood species of wood in the furniture industry. The name Rubberwood involves a variety of misconceptions as to its features and its durability. Rubberwood (also called Parawood in Thailand) is the standard common name for the timber *Hevea brasiliensis* (Baulkwill, 1989).

Enabor and Akachuku (1986) reported that one more vital feature of Hevea brasiliensis that was very important in the modern world was that *Hevea brasiliensis* was the most ecologically friendly lumber used in today's furniture industry. Dramatic changes in world economy plus the occurrence of natural disaster in some parts of the world necessitated the need for quality alternative hardwood timbers.

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Over 52,000 or more different products are made directly or indirectly from rubberwood. The most important part of rubber tree from the grower's point of view is the bark, which contains the latex-producing tissues. The primary and major product of rubber-latex (the milky juice obtained from the rubber tree) is very useful as it contains about 25-45 percent rubber by weight and can be processed into secondary products such as crepe rubber, crumb rubber and sheet rubber for onward processing into finished goods. (Kochhar, 1986). Apart from latex, the rubber tree produces seeds and wood, which are also of economic values to the grower. Before the oil boom in the 1960's, Nigeria was among the World's leading rubber producers. Between 1957 and 1960, Nigeria was the biggest producer of natural rubber in Africa and ranked 3 percent of the world output (Purseglove, 1968).

## Materials and Methods

Density was obtained by Gravimetric methods developed by Smith (1954). In this method, wood sample was obtained as oven-dry weight of $103+2^{o}C$ to green wood volume ratios. Green wood volumes were measured using water displacement method. Oven-dry weights obtained after the sample green volumes are dried in an oven at $103+2^{0}C$ to constant weight;

wood sample was coated with paraffin wax and then completely saturated with water by immersion therein, and by subsequent application of an intermittent vacuum. It was then dried out in an oven. Density was calculated using the Gravimetric method expressed as equation 2.

$$W_D = \frac{1}{\frac{ws - wo}{wo + \frac{1}{\frac{1}{1.53}}}} \quad \text{---------- Eq. 2}$$

expressed in $g/cm^3$

where:

$W_D$ = wood density

$w_S$ = saturated weight of specimen

$w_O$ = oven-dry weight of specimen

1/1.53 = reciprocal of the density of actual wood substances

## Sample Preparation

The Wood Laboratory of Forestry Research Institute of Nigeria, Ibadan was used for the processing and eventual determination of the density of the rubber wood. Samples of five mature boles of rubber trees were randomly selected and felled from the rubber plantation of Michael Okpara University of Agriculture, Umudike in Abia State Nigeria. The trees were felled at breast height (1.3m above ground level) and three logs of 1.2m each were removed from each of the felled trees at 45%, 65% and 75% respectively to obtain the base, middle and top for the five trees. Centre plank of 0.06 metres from the pith were removed from each of the three logs in order to obtain fifteen samples and they were processed at the wood workshop section of Forestry Research Institute of Nigeria, Ibadan.

Diagram of the Extracted Billet

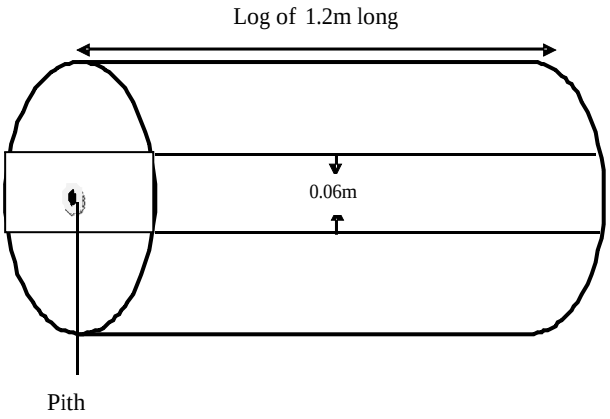


Fig. 2: Diagram of a Billet

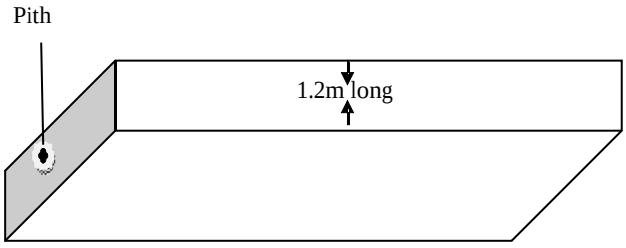


Fig. 3: Diagram of the Centre plank Extracted from Billet

## Statistical Analysis

The data obtained for the wood density of rubberwood were analysed using Analysis of Variance according to Steel and Torrie (1980).

## Results and Discussions

### The pattern of variation in density along the boles and between the trees

Table 1 shows the mean wood density along the individual trees of *Hevea brasiliensis*. The mean values of the wood density along the bole of each of the five trees of the *Hevea brasiliensis* at 45%, 65% and 75% levels of total height which gave the base, middle and top respectively were summarized. It showed that the top of tree 2 which was at the 75% level had the highest density of 562.50kg/$m^3$, followed by its base at 45% level, which have a density of 542.50kg/$m^3$. The middle of tree 1 which was at 65% level of total height had a density of 533.83kg/$m^3$, while the base of tree 3 had the lowest density of 395.0kg/$m^3$ (Table 1). The average of the within rubber tree ranges from 494.83 ± 14.19 to 489.60 ± 20.13 kg/$m^3$.

Table 1. Summary of the mean wood Density along the Individual trees of *Hevea brasiliensis*

| Trees | Bole (Mean ± SE) Base($kg/m^3$) 45% | Middle($kg/m^3$) 65% | Top($kg/m^3$) 75% |
|---|---|---|---|
| 1 | 519.17± 24.46 | 533.83±28.97 | 481.67±13.79 |
| 2 | 542.50±12.80 | 507.50±10.16 | 562.50±20.71 |
| 3 | 395.0±33.94 | 415.0±18.66 | 465.83±9.26 |
| 4 | 482.50±26.85 | 531.67±17.11 | 471.67±20.56 |
| 5 | 510.0±20.86 | 460.0±25.77 | 492.50±6.64 |
| Average | 489.83±23.78 | 489.60± 20.13 | 494.83±14.19 |

In Table 2, the statistical result of the density of the rubber wood between the five trees showed that the means of trees 1, 2, 3, 4 and 5 were 511.56, 537.50, 425.28, 495.28 and 491.42$kg/m^3$ with tree 2 having the highest mean value (fig. 5). The standard errors are given as 13.77, 10.16, 14.65, 13.62 11.81 and 12.80 respectively and average mean density of the tree was 491.42.

Table 2. Summary of the mean wood Density between the five Trees of the *Hevea brasiliensis*

| Trees | Mean Density($kg/m^3$) |
|---|---|
| 1 | 511.56 ± 13.77 |
| 2 | 537.50 ± 10.16 |
| 3 | 425.28 ± 14.65 |
| 4 | 495.28 ± 13.62 |
| 5 | 487.50 ± 11.81 |
| Average | 491.42 ± 12.80 |

Data are mean values (±SE) of five trees of *Hevea brasiliensis.*

## Conclusion

The test on wood density of rubber shows that the strength of a timber depends on the physical properties. The results obtained in this study have provided quantitative information on the density of *Hevea brasiliensis* for utilization purposes in building construction, or for other purposes such as the manufacture of furniture. The results from all tests indicated that *Hevea brasiliensis* is suitable for furniture and construction purposes, and hence is highly recommended for these purposes.

## Recommendations

The demand for indigenous wood species such as *Gmelina arborea, Terminalia ivorensis, Milicia excelsa* etc has led to their overexploitation and consequently decrease their survival in Nigeria. The population of these species are borne out of its favourable mechanical durability and aesthetic properties which are gradually diminishing. Apart from having small diameter, these indigenous trees are also characterised by juvenile wood with large proportion of sapwood which is not as durable as the mature tree of the species.

i. Therefore, efforts should be geared towards creating awareness on the suitability of rubberwood in the construction purposes and not only for latex production based on the results of this work.

ii. Also, further studies on rubber plantation in other parts of the country are required to provide more insight into the physical properties of rubber.

iii. The heritability of important features of rubber wood should also be investigated conclusively to enhance the possibility of tree improvement in order to make their utilization economically visible.

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