Short communication

LUMBER RECOVERY FROM SELECTED PLANTATION-GROWN HARDWOOD SPECIES IN ONIGAMBARI FOREST RESERVE, SOUTHWEST NIGERIA

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ABSTRACT

Lumber yield and wastes from plantation grown species were examined for *Gmelina arborea, Cederala odorata and Triplochiton scleroxylon*. A total of 90 logs (30 per species) harvested from a 38 years old plantation on contiguous sites were randomly selected and sawn around into test lumber dimensions of 2.5cm x 30cm x 4m (1" x 12" x12'), 5cm x 15cm x 4m (2" x 6" x12'), 5cm x 10cm x 4m (2" x 4" x12'), 5cm x 7.5cm x 4m (2" x 3" x12') and 5cm x 5cm x 4m (2" x 2" x12'). The exercise was performed as much as practicable to minimize wastes. Gross volume and yield of the tree species vary significantly. The wood conversion process resulted in 56.93%, 59.78% and 60.86% lumber recovery for *Gmelina arborea, Triplochiton scleroxylon and Cederala odorata* respectively. Statistically, the gross lumber recovery (GLR) of *Triplochiton scleroxylon* was not significantly different from that of *Gmelina arborea* at $P \leq 0.05$. However, GLR for *Cederala odorata* differs significantly from that of *Gmelina arborea* at the same probability level.

Keywords: Hardwood lumber yield, recovery, wastes

INTRODUCTION

The conversion of logs to lumber consists of sawing logs into planks, squaring the edges, and cutting them to nominal dimensions. Log conversion is profitable if waste is minimized and merchantable lumber is derived as much as possible. Modern day log conversions emphasize that wood raw material must take cognizance of quality and yield of the product. This is because contemporary demand for construction and utility wood exceeds the production capacity of the natural forest, which has limited yield per hectare over time (Adegbehin 1992).

Needless to say, plantation development is a regeneration technique that serves the complimentary purposes of supplying and meeting the growing domestic demands for lumber. In Nigeria, hectares of plantation were established to meet the shortfall in wood supply for the ever-increasing human population. The sustainability of available plantation stock is however a function of wood processing and utilization efficiency. Efficient conversion of logs helps to reduce pressure on forest stocks. Similarly, the technical efficiency of sawmills influences the quality of available logs. Timber quality derives from the physiognomy and technical properties of wood. These parameters are influenced by forest tending practices, timber procurement and merchandising arrangements. That means to say, efficient forest management and wood conversion methods can substantially improve lumber recovery.

In the last fifteen years, there has been a serious depletion in number of merchantable tree species from the natural forest in Nigeria due to inefficient conversion of logs. In order to maximize the utilization of the current stock of plantation grown species and to conserve through improve lumber processing there is the need to examine their conversion. In the main, this study was carried out to determine lumber recovery factor in some plantation grown wood species with a view identifying factors that influences recovery, promoting greater efficiency in lumber recovery.

MATERIALS AND METHOD

Plantation species namely: *Gmelina arborea, Cederala odorata and Triplochiton scleroxylon* sampled for this study were removals from experimental plots of Forestry Research institute of Nigeria (FRIN) plantations at Gambari forest reserve of Oyo state. The experimental stands were planted at 1.83x 1.83 espacement in a contiguous 40m x 40m plantation. Trees with diameter at breast height (d.b.h) above 5 feet (1.524m) were felled, converted into logs, assigned numbers and moved to the FRIN-Industrial development unit (FRIN-IDU) for conversion. Thirty logs each of *Gmelina arborea, Cederala odorata and Triplochiton scleroxylon* randomly selected were rolled out and assigned serial sawing numbers. The girth measurements were taken using meter tape. Standard length of 12ft (4m) was taken for every log and the cubic volume was determined using hoppus volume table because it is a preferred measure of log volume measurement in commercial sawmills. French made CD6 horizontal band saw was used in the conversion process.

The logs were sawn into dimension lumber best suited for appearance noting the cracks, splits, shape and defects. The test sawing dimensions were 2.5cm x 30cm x 4m (1" x 12" x12'), 5cm x 15cm x 4m (2" x 6"x 12'), 5cm x 10cm x 4m (2" x 4" x12'), 5cm x 7.5cm x 4m (2" x 3" x12') and 5cm x 5cm x 4m (2" x 2" x12').

Volume and yield calculations

The volumes of the round logs were determined using the mean of the girth measurements of log taken at both end in conjunction with the lengths. The dimension of all marketable lumber obtained from each saw log were measured and used in calculating the volume of output. The volume of sawdust generated was calculated as the product of the total area of the sawn cut and sawn kerf thickness as described by Huuhtanen (1975).

Lumber recovery

Lumber recovery ratio was determined as a percentage of the volume of marketable sawn wood output to the gross volume of the log input into the mill (Dobie 1972). This became an efficiency index in the conversion process.

Wastes

Volume of wastes was taken as the difference between the volume of log input and that of sawn wood output. The wastes consist of all unmarketable wood products (slab and sawdust) after processing.

Analysis of variance (ANOVA) was used to determine if there significant variation in volume recovery of among three species of wood. The dependent variable for volume was percentage of cubic volume of lumber per gross cubic log volume expressed as a percentage. It is calculated by dividing the total value of lumber produced by the volume of logs multiplied by 100.

RESULTS

The lumber recovery and wastes generated from the three species are presented in Table 1. Sawnwood recovery ranges from 56% to 61% with the greatest recovery found with *Cederela odorata*. *Cederela* had the highest sawn wood recovery of 12.829m^3, closely followed by *Triplochiton scleroxylon* with 10.23m^3 and *Gmelina arborea* having 8.283m^3 of sawnwood recovery.

Table 1. Production parameters for the three species

Species	*Number of logs*	*Volume of logs m^3*	*Sawnwood recovery m^3*	*Volume of waste m^3*	*Percent recovery (%)*
Cederela odorata	30	21.078	12.829	8.249	60.86
Trip. scleroxylon	30	17.111	10.230	6.81	59.78
Gmelina arborea	30	14.549	8.283	6.266	56.93

Table 2 shows the proportion of wastes in the total wood biomass. The waste from the logs is the sum total of all the portions of the logs, which are not, recovered as marketable lumber. These include slabs, sawdust and bark. The study revealed that *Gmelina* had the highest volume of wastes put together but *Cederela* had the highest volume of bark. The difference in the bark of *Triplochiton* and *Gmelina* is minimal. Generally, the percentage of sawdust generated for the three species is fairly constant but the amount of slabs and off-cut for *Gmelina* was higher than for *Triplochiton* and *Cederela*. Gross volume recovery is significantly different for *Cederela* and *Gmelina* (Tables 3 & 4) but least significant difference (LSD) analysis showed that volume recovery from *Triplochiton* is generally comparable to the rest.

Table 2. Proportion of waste components in total wood biomass

Species	• *Percent of slabs and off-cut (%)*	*Percent of sawdust (%)*	*Percent of bark (%)*	**Total percent of waste (%)*
Cederela odorata	17.64	8.3	13.2	39.14
Trip. scleroxylon	20.12	8.3	11.8	40.22
Gmelina arborea	23.27	8.3	11.5	43.07

* calculated as percentages of log volume

For *Gmelina arborea*, Figures 1 & 2 showed that recovery is basically a function of the log size (wood biomass determinant) and wastage. A close examination of the data revealed that as volume of waste increased, the lumber recovery actually dropped.

Table 3. Analysis of variance for percentage cubic volume recovery

Source	*df*	*MSE*	*F-value*	*P-value*
Number of logs	29	6172.67	73.45	0.61ns
Species	2	513.52	6.11	0.31ns
Error	58	9234.78		
Total	89			

Table 4. Least Significant Difference of volume recovery in the three species

Treatment	Mean (of Gross Volume)
Gmelina arborea	56.93a
Triplochiton scleroxylon	59.78ab
Cederela odorata	60.86b

N.B. Means with the same letter are not significantly different at 0.05

DISCUSSION

The dimension of sawn timber that comes out of a log is indeed a compromise between the market preference and the sawmillers wish to get maximum recovery from conversion. Hence, gross recovery is related to profitability in the sawmill. It is also a measure of how a mill has been run and how efficiently round log is processed. Gross recovery can be defined as the total volume of utilizable and marketable lumber in relation to the total volume of log input in the mill. Analysis from the three plantation-grown timber shows that *Gmelina arborea* has the least recovery ratio of 56.93% followed by *Triplochiton scleroxylon*, 59.78% and *Cederala odorata* with highest sawn timber recovery ratio of 60.86%. The mean values of lumber recovery obtained from logs of *Cedrela odorata* were significantly higher at 5% level of probability than the mean value of *Gmelina arborea* but not significant when compared to that of *Triplochiton scleroxylon.*

The variations in volume of lumber recovered from the three species can be attributed to the size of logs, wood quality and form (tapering). Physical observation shows that logs from *Gmelina arborea* tapers more when compared to *Triplochiton* and *Cederala*. Badejo and Giwa (1985) had earlier noted that log form arising from taper effects resulted in low lumber recovery. Present result shows that *Gmelina arborea* have smaller diameters compared to *Triplochiton* and *Cederela* that are also relatively small in diameter compared to notable large diameter wood species. It was observed that the CD horizontal band saw machines are not built to saw small diameter logs, hence there is need to upgrade the sawing equipment to improve accuracy and increase conversion efficiency (Akande 1993). Most sawmills in Nigeria are established to convert large diameter logs, which were ubiquitous at the time of establishment, hence the proliferation of mills to harness the abundant tropical timber resources in the country. Today, there is a need to restructure the forest industries to utilize more efficiently the smaller-diameter plantation timbers. The quantum of sawdust wastes from all the species was uniform, while the proportion of bark wastes from the three species varies (Table 2). *Cederela* has a high volume of bark waste compared to *Triplochiton* and *Gmelina*. Uniformity of the volume of the sawdust is as a result of same thickness of the saw kerf of the machine used in sawing. The high volume of bark in *Cederela* could be traced to prolific cambium activity after the primary tissues are fully formed.

CONCLUSIONS

In this study, comparative analyzes of lumber yield from the three plantation grown wood species showed that a correlation exists between log size and gross wood recovery. Recovery is a function of log size and is found to be higher for logs of larger diameter. In consequence, the gross lumber recovery for *Gmelina arborea, Triplochiton scleroxylon and Cederala odorata* are 56.93%, 59.78% and 60.86% respectively.

As wood recovery goes up, loss of wood biomass as wastes attenuates. Arising from wood quality variation, it is conceivable that lumber recovery from plantation grown species would generally be higher than those from natural forests. This may be attributed to the fact that there is usually low percentage of deformed logs in plantation regimes, hence it is recommended that sawmillers should be involved in the establishment of private plantations for high quality log production. The sawmiller can also improve efficiency in lumber recovery by investing in sawmilling equipment that will handle smaller diameter logs and machines that can do further recovery from slabs. Badly formed and tapered logs gave very low recovery, when compared to logs having good forms and qualities, and they usually carry lower merchandize value.

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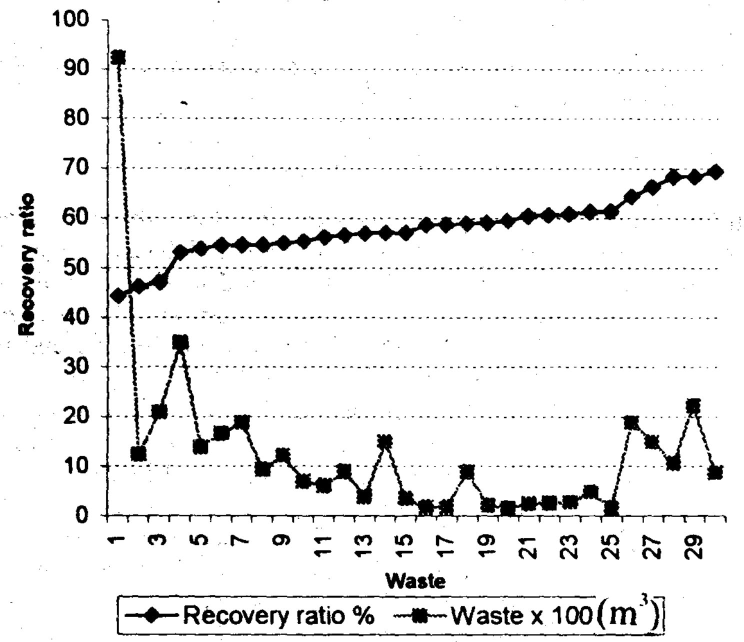

Figure 1. Graph of *Gmelina* wood recovery versus wastage

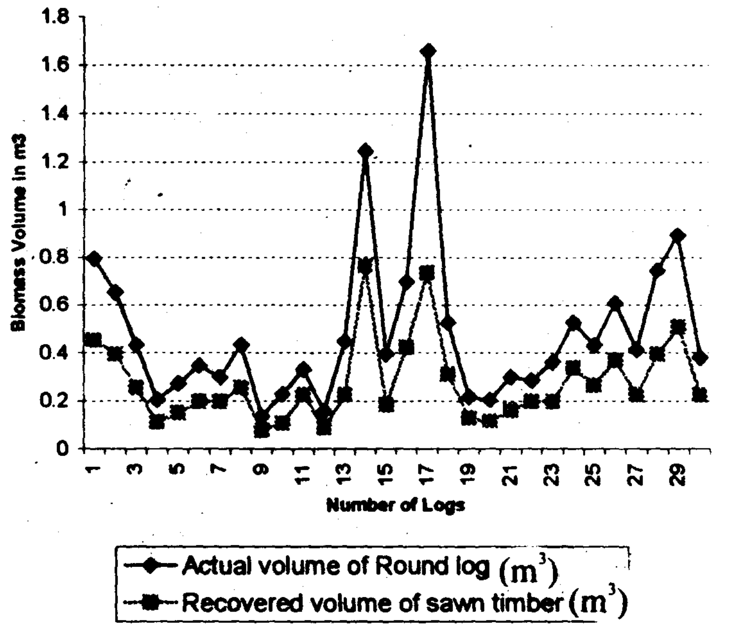

Figure 2. *Gmelina* sawnwood recovery as a function of input wood biomass

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