

Environmental Impact Assessment of Selected Sawmills in Ile-Ife, Osun State, Nigeria

¹*ONEFELI, A.O., ¹O.Y. OGUNSANWO, ¹T.L.OLUWAYOMI,
²M.O.O. ISESE, ¹I.B. CHENGE and ¹K.E. OKON

¹Department of Forest Resources Management, University of Ibadan,
Ibadan, Nigeria

² Forestry Research Institute of Nigeria (Moist Forest Research Station),

*Email: ftaxonomist@gmail.com

Abstract

This study assessed the environmental impact of selected sawmilling industries in Ile-ife, Osun state, Nigeria. Data were obtained through oral interview, questionnaire administration, visual observation and direct measurement of logs and sawn timber produced. Results were analyzed using descriptive statistics and Chi-square. Results showed that majority (57.1%) of the sawmill employees do not have any other alternative source of income and thereby depend mainly on earnings from the sawmilling operation for their livelihoods. The estimated Lumber Recovery Factor (LRF) differ based on the sawmill and timber species. The observed plant indicator of the waste dumpsite was *Bidens pilosa*. Perceived health ailments associated with sawmilling operations by the respondents are Catarrh (66.7%), Headache and Fatigue (14.3%) and cornea inflammation (4.8%). These ailments significantly depend on level of income as well as job categories ($p < 0.05$). Other perceived environmental impacts include noise, emission to air, ground and water.

Introduction

Forest based industries, such as sawmills, constitute one of the largest in the Nigerian economy (Ogunsanwo *et al.* (2005). Any industry which uses forest produce as its principal raw material or whose activities are directed towards obtaining the raw materials from the forest is referred

to as forest industry (Popoola and Adebuseye, 2002). Forest industries in Nigeria have contributed immensely to industrial development, employment, and human welfare (Akande, 2005). For instance, Adeyoju (2001) emphasized that the products from these industries are mostly used as raw materials by other companies such as NEPA, NITEL, commercial furniture makers and boat makers. The industries form the production base for a wide range of products including processed timber, plywood, pulp and paper, particleboard, sawn wood, etc. However, in the last two decades, there has been a great concern as to whether the operational status of these industries is consistent with contemporary drive towards sustainable forest management and environmental control (ITTO, 2001; Akande *et al.*, 2006).

Annual cut of timber by the forest industries exceeds replenishment status to the extent that western environmentalists now criticize tropical timber producers for their forest management practices. These environmentalists call for boycotts of tropical timber products that are not certified as derived from well-managed forests. By 1998, an expert Group meeting held in Kyoto, Japan discussed "Clean Development Mechanisms and Sustainable Industrial Development" (UNIDO, 2000). A major resolution of this summit was that African industries should build institutional and infrastructure capacity to take full advantage of opportunities available in world trade. This issue became topical to the extent that the International Tropical Timber Council, by the year 2003, committed about \$6.6 millions in grants for initiatives promoting sustainable forest management, greater transparency in tropical timber trade and the development of sustainable forest based industries (ITTO, 2002; Patrick and Jean, 2007).

For a variety of reasons, Nigeria's forest industry has lagged behind in adopting state-of-the-art technologies in forest produce processing when contrasted to situations in some other sub-Saharan West African countries. This has made recovery from Nigerian sawmills, which account for about 93.32% of the total number of wood based industries in Nigeria to be as low as 30% (Adeyoju and Wazireribe, 2005; Lucas and Olorunnisola, 2002; Lensile, 1980; Sanwo, 1981). Consequently, there is production of large quantity of wastes. According to Larinde and Popoola (2008), wood wastes are generated at every stage of processing, starting from harvesting, and transportation to primary and secondary wood conversion operations. Onosode (1988) stated, that sawmills generate considerably higher wastes

than any other forest industry. These wastes have contributed heavily to most of the environmental problems, such as the climate change experienced today either through burning, dumping or utilization. PREGA (2004) reported that for 100kg wood waste dumped, there would be approximately 8kg of methane (CH₄) emitted to the atmosphere. Methane is more effective heat-trapping agent, contributing up to 20% of the greenhouse effect with a global warming potential of 21 times that of CO₂ (IPCC, 2007; Winjum, 1998). According to World Bank Group (WBG, 2007), environmental issues associated with sawmilling activities include solid waste generation, emissions to air, wastewater, noise and fire. Furthermore, many of the existing Nigeria sawmills are owned and managed by businessmen, who are not sufficiently sensitized on environmental and efficiency imperatives.

To promote sustainable management of the Nigerian sawmills and mitigate the possible aftermath effect associated with wood conversion activities in these sawmills therefore, there is need to carry out environmental impact assessment of the industry. Majority of these sawmills are located in south-western Nigeria of which Ile-Ife is a part. (Sanwo, 1982).

Environmental impact assessment (EIA) is defined as an activity designed to identify and predict the impact on man's health and well being, of legislative proposals, policies, programmes, projects and operational procedures, with the view to interpret and communicate the information about these impacts (Essaghah and Adibe, 1999). Aruna and Himans (2005) defined it as a process that identifies, predicts and describes in appropriate terms the pros and cons of a proposed development action. According to Erickson (1994), environmental impact assessment requires seeing the environment as the aggregate of things and conditions that surround or envelop every living and nonliving thing. The environment is not just the forest; it is also all the processes that take place in, around and because of that forest (Popoola and Akande, 2001). The environment is also not merely those things that are not human: it includes humans and things, processes, and conditions that pertain to humans. Currently, "environment" simply means the physical, chemical, biological and social entities, conditions and dynamics that surround us (Magelli *et al.*, 2009). EIA is, therefore, the effort to: determine how our actions might change these entities, conditions and dynamics; establish criteria by which to evaluate the desirability of such

changes and mitigates selected changes by appropriate engineering or management techniques.

Methodology

Study Area

This study was carried out in two different sawmills. They are Abudu and Mayashau Sawmills located approximately on latitude 7°24'-9°53'N and longitude 4°53'-8°3'E. The mills fall within the jurisdiction of Ife North Local Government Area of Osun State, Nigeria. Purposive sampling was used to select the sawmills based on the fact that most of the other sawmills were not functioning as at the time of the study.

Method of Data Collection

Data for this study were collected using oral interview, questionnaire administration, visual observation and quantitative variable measurement. Quantitative measurements of log length, diameter at the base and top of 6 and 4 logs were taken with meter tape and girthing tape in both sawmills respectively. Number of cuts, the headrig passes through the processed logs and the sawkerf thickness were equally noted in the course of sawing. After conversion, length, breadth and thickness of each sawn timber were also measured with the use of meter tape. Total enumeration was used for questionnaire administration to all the sawmill staff encountered.

Data Analysis

Data from questionnaires were analyzed with the use of descriptive statistics and Chi-square analysis. The Smmalian's formula for volume estimation was used to compute the volume for individual logs (input volume). The formula is given as:

$$V = \frac{(A_b + A_t)H}{2} \quad \text{or} \quad V = \frac{(\pi D_b^2 + \pi D_t^2)H}{8}$$

.....1 (Thomas and Jackson, 2004)

Where, V = Volume of logs, A_b = Area at the base, A_t = Area at the top, D_b = Diameter at the base, D_t = Diameter at the top and H = Length of the logs.

Lumber recovery factor was calculated using the formula:

$$\text{LRF} = \frac{OV}{IV} \times 100 \dots \dots \dots (2)$$

(Sanwo, 1982)

Where, IV= Input volume, OV= Output volume

The volume of sawdust generated was calculated using the formula by Kenneth (2002):

$$\text{SDV} = L \times \text{CF} \times \text{NC} \times \text{SK} \dots \dots \dots (3)$$

Where, SDV = volume of sawdust, L= Log length, CF = Correction factor, NC = Number of cut and SK= Sawkerf thickness

Results and Discussion

Socio-demographic Characteristics of the Respondents and Sawmilling Activities

Results of the socio-demographic characteristics of respondents are presented in Table 1. The number of employees in the sampled sawmill was 21 out of which Abudu sawmill employed 11 (52%) while Mayashau employed 10(47.6%). Majority 11(52.4%) of the employees were single while 10 (47.6%) were married with 5(23.8%) having 2-5 household size and 5(23.8%) have household size of 6 persons and above. It may be therefore suggested that sawmilling operations are for young men who are strong enough to man the various activities involved in the operations. The highest educational qualification of the respondents was secondary school certificates 6 (28.6%), while 8(38.1%) of the respondents also had primary school leaving certificate, 7 (33.3%) had no formal education as at the time of the study. The identified categories of staff employed in the two sawmills include sawdoctors, machine operators, loaders/offloaders, cleaners and supervisors (Table 1). The loader/offloaders, who are involved in materials handling, including sorting, lifting, loading and offloading, constituted about 62% of the total workforce.

Results (Table 1) from this study also showed that majority 17 (80.9%) of the workforce did not have any pre-employment training. Apprenticeship was the only mode of pre-employment job training for the workforce in the two sampled sawmills, and this was for only sawdoctors and sawyers. The training duration varied from mill to mill, ranging from one to three years. No form of requisite training was mandatory for all other categories of mill employees. Also, no refresher programme was

available in any of the mills for all categories of sawmill staff. While there is nothing inherently wrong in apprenticeship as a form of technical training, the approach adopted in these sawmills was considered faulty in the absence of well-defined curricula, periodic skill acquisition, evaluation programme, and specified duration of training activities. This situation is detrimental to the growth and development of the sawmilling industry since a poorly trained worker cannot provide optimum performance. A skilful sawyer and a good sawdoctor are essential to obtaining maximum volume and lumber recovery during log conversion operations. Anon (1972) and Olorunnisola and Oyelami (1997) had reported that poor sawdoctoring was a major factor contributing to excessive and avoidable wood-waste generation in Nigeria's small-scale sawmills.

Despite the fact that majority of the employees of the sampled sawmills did not pass through pre-employment training, 3 (14.3%) and 2(9.5%) of them had 20-24 years and 15-19 years of experience in the job respectively. In addition, about 10% and 38% of them also had between 5 and 14 years on the job experience. This corroborates the study by Lucas and Olorunnisola (2002), who reported that the conglomerate of most of the Nigeria's small scale sawmills labourers are experienced though with little or no education.

The result (Table 1) of the employees monthly income level showed that majority 16 (76.2%) of them earn less than ₦12,000 per month. Nevertheless, this amount is highly ridiculous for a man to manage with, despite the fact that majority of them spend at least 8hours/day in the operation (Figure 2) while (57.1%) did not have any other alternative source of income. They therefore depend on this meagre amount for their livelihood, which can go a long way in negatively affecting their attitude to work.

Table 1: Socio-demographic Characteristics of the Respondents

Variable	Freq.	Perc. (%)
Number of Employees		
Abudu sawmill	11	52.4
Mayashau sawmill	10	47.6
Total	21	100
Marital Status		
Single	11	52.4
Married	10	47.6
Household Size		
1	11	52.4
2-5	5	23.8
6 & above	5	23.8
Educational Level		
Primary Education	8	38.1
Secondary	6	28.6
No Education	7	33.3
Staff disposition		
Sawdoctors	2	9.5
Machine operators (sawyers)	2	9.5
Loaders/Off-loaders	13	61.9
Cleaners	2	9.5
Supervisors (Managers)	2	9.5
Pre-employment Job training		
Yes	4	19.1
No	17	80.9
Work Experience		
Less than 5	6	28.6
5-9	8	38.1
10-14	2	9.5
15-19	2	9.5
20-24	3	14.3
Level of Income (N g)		
<12000/month	16	76.2
12000-23000/month	1	4.8
Above 24000/month	4	19
Alternative Source of Income		
Yes	9	42.9
No	12	7.1

Chi-square results (Table 2) shows that the income level of sawmill employees significantly depends on job categories ($p < 0.05$). This can be adduced to the fact that some employees such as the supervisors, machine operators and the sawdoctors earn more compared to other category of employee. On the other hand, year of experience, educational background and number of working hours per day had no significant effect on the income earned by the employee ($p > 0.05$). This may have contributed to a high number of illiterate observed in the sawmills.

Table 2: Effect of some selected socio-demographic characteristics on Employees' level of income

Variable	Chi-square value	df	p-level
Income VS Job description	45.53	28	0.019*
Income VS Year of experience	103.54	91	0.174ns
Income VS Educational background	14.51	14	0.412ns
Income VS No of working hour/day	41.52	36	0.243ns

*: significant ($p < 0.05$), ns: not significant ($p > 0.05$)

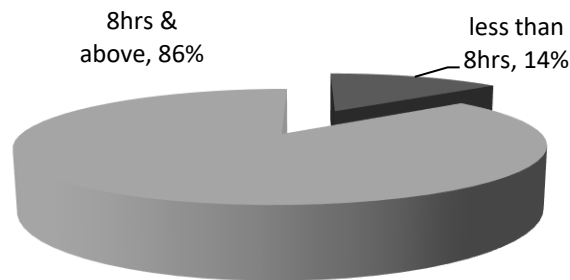


Figure 2: Sawmill employees working hours per day

Log Supply

A total of 19 timber species with *Cola gigantea* having the highest frequency (29) and relative density (29.3%) were surveyed in the two sawmills (Table 3). However, most of these tree species fall into the group of lesser known species listed by Aiyeloja *et al.* (2011). The sawmills depended only on log from government forest reserves around the Ile-ife city. They neither obtain logs from free areas nor plantation. Tree species

obtained from the reserves were however abundant about ten years ago and presently emphasis is on the conversion of the lesser known species. Apart from this, log size has also reduced to the extent that sawmills operators now harvest trees with girth as small as 10cm for conversion. This undoubtedly has significant effects on the quantity and quality of lumber as well as the quantity of waste produced in sawmilling industry. According to Ogunsanwo (2001), log girth is one of the major determinants of the amounts of waste generated in wood conversion, the smaller the girth, the higher the proportion of waste generated, which will in the long run negatively impact the environment.

Table 3: Timber Species Available for Conversion in the Sampled Sawmills

Botanical Name	Local Name	Family	freq.	R.D(%)
<i>Cordia milleni</i>	Omo	Bignoniaceae	7	7.07
<i>Lannea welwithshi</i>	Opon	Anacardaceae	4	4.04
<i>Funtumia elastica</i>	Ire	Apocynaceae	2	2.02
<i>Celtis zenkeri</i>	Ita	Ulmaceae	11	11.1
<i>Recinodendron heudelotii</i>	Putuputu funfun	Euphorbiaceae	4	4.04
<i>Cola gigantea</i>	Egigun	Sterculiaceae	29	29.3
<i>Alstonia bonnei</i>	Ahun	Apocynaceae	4	4.04
<i>Ceiba petandra</i>	Araba	Bombaceae	4	4.04
<i>Albizia zygia</i>	Ayunre	Leguminosae	2	2.02
<i>Sterculia rhinopetala</i>	koko igbo	Sterculiaceae	5	5.05
<i>Trichilia heudelotii</i>	Ako	Meliaceae	4	4.04
<i>Ficus spp</i>	Obobo	Moraceae	3	3.03
<i>Sterculia tragacantha</i>	Alawefon	Sterculiaceae	6	6.06
<i>Irvingia grandifolia</i>	Karakoro	Irvingiaceae	6	6.06
<i>Burkea africana</i>	Apasa	Caesalpiniaceae	2	2.02
<i>Chenopodium ambrosioides</i>	Asinporin	Chenopodiaceae	4	4.04
<i>Corton penduliflouris</i>	Eru	Euphorbiaceae	2	2.02
<i>Piptadeniastrum africanum</i>	Agboyin	Leguminosae	2	2.02
<i>Blighia sapida</i>	Isin	Sapindaceae	3	3.03

Log transportation to the mills was by means of truck and the logs so transported to the mills are stored on the bare ground in the Logyard. This open-yard storage causes checking of lumber produced from such logs and also encourages insect and fungi attack on the sapwood (Olorunnisola and Lucas, 2005). Hence, much waste is generated in the mills.

Log Conversion Practices and Lumber Storage

Table 4 shows that mobile horizontal bandsaws (100%) were installed for primary conversion of logs in the sawmills. None of the sawmills bandsaws were in good condition. According to the interviewed sawyer in *Abudu Sawmill*, the saw-blade breaks consistently during operation, which was also witnessed during the survey. The saw doctor therefore do a lot of work in brading and sharpening the saw-blade frequently to ensure that the sawmill operation is not jeopardized. This was as a result of inadequacy of working capital needed to change the saw after it has been worn out. If this continues in sawmill operation, it will lead to low level of efficiency in the sawmill. In addition, broken circular saw is being employed in reconversion operations in some cases, which also aggravates waste generation in the sawmill. This corroborates Akande (2005), who reported that the use of old and obsolete machines produce dire consequences on the level of efficiency and productivity.

The average daily number of log conversion was 8 for both *Abudu* and *Mayashau* sawmill, when there is steady power supply by Power Holding Company of Nigeria (PHCN). The presumed factors determining the number of daily number of log conversion in the sawmills are power supply, availability of sawdoctor and timber species. It was also discovered that PHCN was the only power source for this two sawmills, there was no alternative power supply (Table 4). This study (Table 4) also revealed, that there was no saw doctor workshop in *Mayashau* sawmill, as a result, the saw doctor make use of the neighbouring sawmill's (*Abudu Sawmill*) saw doctor workshop for saw maintenance. This will negatively affect the lumber recovery of the sawmill and as such encourages waste generation. Additionally, the equipments observed in *Abudu* saw-doctor workshop were not enough. Only swage, brading machine, sharpener, bellows, harmer and chisel were the observed saw doctor equipments. Temporary lumber storage in the mills involved pile-stacking planks of mixed wood species on the bare ground in open yards. This practice is detrimental,

being a typical contributory factor to the occurrence of common lumber defects such as checks splits, warps, insect and fungal stains (Lucas, 1983).

Table 4: Perceptions of the respondent on Sawmilling activities

Variable	Frequency	Per.(%)
Source of Logs		
Plantation	0	0.0
Free areas	0	0.0
Reserves	21	100.0
Location Source		
Ife	21	100.0
Outside Ife	0	0.0
Log transportation		
Truck	21	100.0
Species abundance as before		
Yes	0	0.0
No	21	100.0
Change in log size		
Yes	21	100.0
No	0	100.0
Log storage		
Gantry	21	100.0
Daily Number of Log conversion		
8(Abudu Sawmill)	11	52.4
8 (Mayadhau sawmill)	10	47.6
Machine Type		
Horizontal Band-saw	21	100.0
Vertical Band-saw	0	0.0
Saw doctor Workshop		
Yes (Abudu Sawmill)	11	52.4
No (Mayadhau sawmill)	10	47.6
Power Source		
Generator	0	0.0
PHCN	21	100.0
Method of Waste disposal		
Sold offcuts to bakery,		
Burn Sawdust and sale of slabs		
to carpenter	21	100.0
Where do you dispose waste?		
Around Sawmill	21	100.0

Wood Residue Generation and Utilization

Tree barks, slabs, off-cuts and mis-manufactured lumber and sawdust were the major types of wood residue generated in the sawmills. Sawdust evacuation was a particularly noticeably difficult problem in the mills, none of which had dust extraction systems. The sawdust and the off-cuts are grossly under-utilized in the mills. This is evidenced from the observed offcuts, which have already decayed while some were just undergoing the decay process in the logyard. Although the respondents claimed that the slabs were sold to carpenters for onward furniture making while the off-cuts were bought by the bakery for firewood purpose, yet a lot of them were found in the logyard decayed. The respondent replied that the generated sawdust were deposited around the sawmill and in most cases burnt in order to give space for the subsequent sawdust deposition.

Flora Associated with Waste Dump Site

Table 5 contains the different flora species identified around the two visited sawmills. Generally, majority of these plant species are herbaceous in nature. These plant species include *Sida acuta*, *Datura mete*, *Synedrella nodiflora*, *Chromolaena odorata*, *Solanum torvum*, *Acalypha fimbriata*, *Commelina diffusa* and *Bidens pilosa*. Specifically, *Bidens pilosa* was identified to be the sawdust dump site indicator. This is based on the fact that this plant dominated the surroundings of the dump site of the newly deposited sawdust. The presence of this plant is more pronounced in the old dumpsite; to the extent that the site has been totally covered by this plant species. The result therefore implies that sawdust waste discourages floral species diversity. The result agrees with Anavberokhai (2008) who discovered that most hardwood species solid waste in sawmills contain some heavy metals such as lead (Pb) which inhibit the growth of herbaceous plant owing to their toxic nature.

Table 5: Floral Species associated with Sawmill Waste Dumpsite

Species Name	Local Name	Family
<i>Sida acuta</i>	Iseketu	Malvaceae
<i>Synedrella nodiflora</i>	Aluganbi	Compositae
<i>Chromolaena odorata</i>	Akintola	Compositae
<i>Solanum torvum</i>	Igba-yinrin-elegun	Solanaceae
<i>Acalypha fimbriata</i>	Jinwinini	Euphorbiaceae
<i>Commelina diffusa</i>	Itopere	Commelinaceae
<i>Bidens pilosa</i>	Abere-oloko	Compositae

Negative Impact of Sawmill Activities on the Employee

Result (Figure3) showed that majority (81%) of the respondents rarely go for health check. This may be due to the fact that most (66.7%) of them were only affected by a minor ailment (i.e. Catarrh) (Figure 4). This was followed by fatigue and headache (14.3%). Few (4.7%) were affected by cornea inflammation.

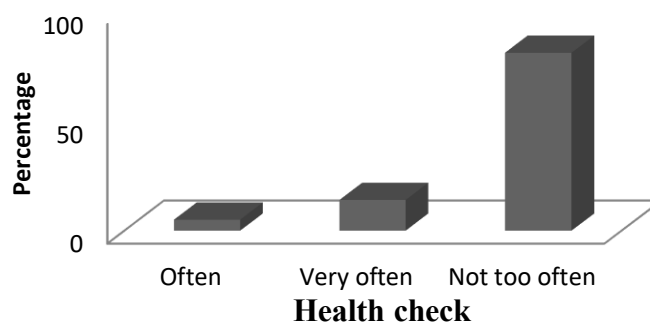


Figure 3: How often the employee visit hospital

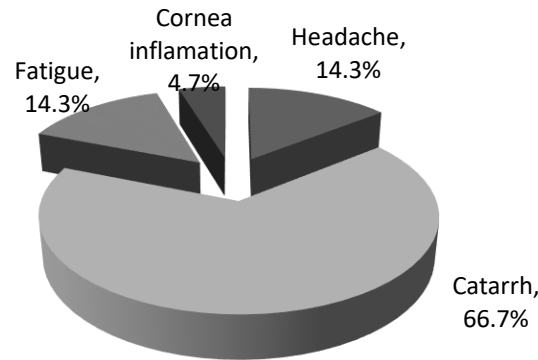


Figure 4: Common ailment affecting the sawmill employees

Chi-square analysis (Table 6) shows that the common ailment affecting the sawmill employees does not significantly depend on the number of working hours per day ($p > 0.05$). On the other hand, common ailments significantly depends on level of income as well as job categories ($p < 0.05$). Those whose work is at the log conversion point (i.e. Headrig location) were more prone to catarrh than other labourers. Also, the high income earners visit hospitals more than the low income earner as a result of their financial capacity.

Table 6: Effect of some selected socio-demographic characteristics on common ailment affecting the sawmill employees

Variable Analyzed	Chi-square value	df	p-level
Common ailment VS Number of working hours/day	14.702	18	0.682ns
Common ailment VS Level of income	37.846	21	0.013*
Common ailment VS Job category	22.786	12	0.030*

*: significant ($p < 0.05$), ns: not significant ($p > 0.05$)

Lumber Recovery Factor (LRF) and Wastes Generation

Lumber production technology was essentially similar in the sawmills. Both of the sawmills were using CD series horizontal bandsaw. However, productivity in Abudu sawmill was better with 34.13% lumber recovery, while LRF in Mayashau is 27.67% (Table 7). This result is in consonance with Onefeli (2009); Adeyoju and Wazireribe (2005); Lucas and

Olorunnisola (2002); Lensile (1980); and Sanwo (1981), who emphasized that Nigeria sawmills LRF is as low as 30%. If operations continue this way in the sawmills, there is a likelihood of further reduction in this ridiculous LRF. Hence, a lot of wastes will be generated, which aggravate the environmental problems from sawmills. The percentage of slabs and sawdusts from Abudu sawmill is also smaller than that from Mayashau sawmill (Table 7). There is however no doubt that Abudu sawmill was more efficient than Mayashau.

Table 7: Lumber Recovery Factor (LRF), Slabs and Sawdust obtained from the Sawmills

Sawmill	LRF (%)	Slabs (%)	Saw dust (%)
Abudu Sawmill	31.92	56.43	11.65
Abudu Sawmill	32.16	60.13	7.7
Abudu Sawmill	37.23	52.41	10.35
Abudu Sawmill	32.43	53.05	14.52
Abudu Sawmill	34.64	58.32	7.04
Abudu Sawmill	36.42	39.92	23.66
Pooled average	34.13	53.38	12.49
Mayashau Sawmill	30.85	59.32	9.83
Mayashau Sawmill	28.79	50.49	20.72
Mayashau Sawmill	26.04	53.8	20.15
Mayashau Sawmill	25.01	58.12	16.87
Pooled average	27.67	55.43	16.89

Aggregate of sawmill waste volume based on the processed wood species shows total waste generated varies from species to species. On the average, *Alstonia boonei* generated the highest total waste volume per log of 495580.12cm³; this was followed by *Cola gigantea* with about 372966.52cm³. *Ricinodendron heudelotii* generated the lowest total waste of 370021.93cm³ per log. When the total waste volume per log was aggregated into slabs and sawdusts, *Alstonia boonei* equally generated the highest volume of slabs (396195.01cm³) sawdusts (99385.12cm³). This is followed by *Cola gigantea*, which generated 313360.17cm³ slabs and 59606.36cm³ sawdusts. *Ricinodendron* had the smallest slabs volume (266194.69cm³), but generated the highest volume of sawdusts (103827.25cm³).

It can therefore be proven from this result that tree species has a great impact on the aggregate of wood wastes. Choice of species therefore will depend on the type of wastes needed. For instance, if more slabs are needed than sawdust, the best species to be chosen for conversion among these tree species will be *Alstonia*. Also, if a sawmiller needed lesser sawdust compared to slabs/offcuts, the preference tree species will be *Cola gigantea*. Furthermore, if efficiency with respect to LRF is the sawmiller priority, *Cola gigantea* will be the best option. In case of reducing environmental pollution resulted from burning of sawdust also, it will be preferable to encourage conversion of more *Cola gigantea* because of its small sawdust volume generation compared to the other two species (see table 8).

Table 8: Partitioned Sawmill Wastes Volume Based on Wood Species

Tree Species	Total waste (cm ³)	Slabs(cm ³)	Saw dust (cm ³)
<i>Alstonia boonei</i>	322668.92	267448.11	55220.81
<i>Alstonia boonei</i>	643338.79	551904.9	91433.89
<i>Alstonia boonei</i>	520732.66	369232.01	151500.65
Mean	495580.12	396195.01	99385.12
<i>Cola gigantea</i>	315059.69	279285.8	35773.89
<i>Cola gigantea</i>	320687.66	267782.93	52904.73
<i>Cola gigantea</i>	536587.24	421279	115308.24
<i>Cola gigantea</i>	319531.52	285092.95	34438.57
Mean	372966.52	313360.17	59606.36
<i>Ricinodendron heudelotii</i>	265462.67	193124.08	72338.59
<i>Ricinodendron heudelotii</i>	333863.31	209629.99	124233.32
<i>Ricinodendron heudelotii</i>	510739.83	395830	114909.83
Mean	370021.93	266194.69	103827.25

Socio-economic Impact (Positive Impact)

It was found that majority of the employees in the two sawmills visited do not have alternative sources of income on which they depend on. Socio-economically, the sawmills have therefore impacted on them by providing them with their livelihood through salary earnings from the job. Although, their incomes are too small to meet their needs under the present Nigerian economy, yet they manage with it to ensure that life still go on. In addition, employees that claimed they have alternative sources of income,

secured such income source through their earnings from the sawmills. For instance, some reported they have two to three motorcycles that generate additional income.

Negative Impact

The negative impact of sawmilling activities on the employee can be direct or indirect. It is direct when the sawmilling operation affect them directly and it is indirect when the operation causes environmental problems such as climate change that will on the long run affect them. Identified negative impacts include headache, catarrh, fatigue and cornea inflammation. It was also observed that the sawmills generates huge volume of wastes, which are burnt in the sawmill. Consequently, this will lead to global warming, which will indirectly affect humans by causing problems like flooding, desertification, household displacement, etc.

Transportation means used in sawmilling activities is another contributor to air pollution. Trucks emit carbon dioxide, nitrogen dioxide, particles, lead, benzene etc. These emissions affect the environment and as such create environmental impact (Brorson & Larsson, 2006). The effect of transportation is noticeable in both sawmills based on the kind of trucks that are used, which emit a lot of smoke into the atmosphere. Other negative impacts of sawmilling activities observed from this study are noise, and emissions to ground and water.

Suggested Mitigation Measures and its Benefits

In order to prevent further negative impact of the sawmilling activities on the employees, there should be provision of protective gadgets such as safety helmet, nose masks, hand gloves, earplugs, eyes glasses, etc. and the employees, especially the manual labourers should be compelled to make use of the gadgets.

Wood waste is a viable energy resource, which can be used to produce low but usable gas for lumber drying and other thermal requirements within mill complex. Biomass energy generation is one of the very few options available to sawmilling industry to drastically reduce their GHG gas emission to the atmosphere. The current trend in developed countries is to generate heat and electricity utilizing available wood waste. The residues from wood processing can form wood based biomass for

Wood Gasification (WG), pyrolysis, alcohol fermentation and Wood Cogeneration Plant (WCP) (Badejo and Giwa, 1985). In wood gasification, producer gas is generated in thermo-chemical conversion process through partial oxidation. Producer gas derived from wood biomass is being used for domestic and industrial heating purposes, for cooking, for stationary power and for motor vehicle application in developed economy. Pyrolysis is a thermal decomposition process that occurs at moderate temperatures with a high heat transfer rate to the biomass particles and a short hot vapour residence time in the reaction zone. It produces a liquid product, pyrolysis oil or bio-oil that can be readily stored and transported. This oil has been successfully tested in engines, turbines and boilers. Also, fuel alcohol is produced by converting wood waste to alcohol by fermentation with yeast. Cogeneration, also known as Combined Heat and Power (CHP) is the production of electricity and heat in one single process for dual output streams (Dutschke, 2006).

Bio-energy generation can benefit the environment by reducing greenhouse gas (GHG) emissions. By reducing the use of diesel fuel and also reducing the practice of wood dumping, the system can save GHG emissions as much as 6691 tons CO₂ equivalent per year (PREGA, 2004). The GHG reduction is achieved in 3 ways: reduction of wood waste; reduction of diesel fuel consumption and reduction of electricity demand. Other benefits can include the reduction of local pollutant due to the use of diesel vehicles. Social benefits of the project include welfare improvement of the workers and poverty reduction due to the opening of new job market.

Conclusion

Environmental Impact Assessment (EIA) is not yet a culture imbibed by the mill operators in Ile-Ife, because sawmill lumber recovery factor is alien to them. There is increase in volume of wastes generated from mills in the study area due to use of obsolete equipments. Most wood wastes are burnt and this increases environmental pollution.

However, sawmill operations in Ile-Ife could be more efficient when complemented with technology improvements; replacing the obsolete headrig with more conventional ones. There is also need for the establishment of sawdoctor training centre in Nigeria especially in Ile-Ife where potential sawdoctors can be trained and the experienced ones can

undergo refresher courses. Government should pursue green investment by establishing plantation of fast growing species, which have minimal taper such as *Tectona grandis* and *Nauclea diderichii*. It should also encourage green enterprise that utilizes waste products for particleboard, briquettes, souvenirs as well as bio-energy production.

References

- Adeyaju, S.K. (2001). Forestry for National Development: A critique of the Nigerian Situation. A lead paper presented at the 27th Annual Conference of the Forestry Association of Nigeria, Abuja, 17-21 September, 2001, pp1-4
- Adeyaju, S.K. and S.M. Warizeribe (2005). Aspects of marketing strategies by the forestry research institute of Nigeria's industrial development unit Ibadan for four selected Sawnwood species. *Proceedings of the 30th Annual Conference of the Forestry Association of Nigeria held in Kaduna State, 7th-11th of November, 2005*. Pp 234-245.
- Aiyelaja, A. A., O.Y. Ogunsanwo and A.P. Asiyebi (2011). Determinants of Preference for Lesser-Known Species among Cabinet-Makers in Oyo and Osun States, Nigeria. *Small-scale Forestry* 10:37-51.
- Akande, J.A. (2005). Environmental and Energy Profile of the Nigerian Forest Industry. *Proceedings of the 30th Annual Conference of the Forestry Association of Nigeria held in Kaduna State, 7th-11th of November, 2005*. Pp 207-221.
- Akande, J.A., C. Adu-Anning E. Ntabe B.O. Agbeja and S.L. Larinde (2006). Quality assessment of status and trends in forest industries of Ghana, Nigeria and Cameroon. Final Report to the African Forestry Research Network (AFORNET, Kenya). 150Pp.
- Anavberokhai, I.O. (2008). Environmental Aspects Review A Case Study of Two Sawmills in Etsako-West, Edo State Nigeria. Master's Thesis in Industrial Engineering and Management, 38p.
- Anonymous (1972). A report on the Assessment and Evaluation of Wood Waste Owing to Bad Sawing and Poor Sawdoctoring. A Monograph published by Western State Forestry Advisory Commission, Ibadan, Nigeria. 25p.
- Aruna, M. and S.P. Himansu (2005). Environmental Impact Assessment process in India and the drawbacks, world bank, 30p.
- Badejo, S.O. and S.A. Giwa (1985). Volume Assessment and Economic Importance of Wood Wastes Utilization of Nigeria. Technical

- Report No. 50, Forestry Research Institute of Nigeria, Ibadan. 5Pp.
BC, (2006). British Columbia. B.C. Min. For. Range, Res.Br., Victoria, B.C.
Tech. Rep.045.<http://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr045.htm>.
- Brorson, T. and G. Larsson (2006). *Environmental Management, how to implement an environmental management system within a company or other organization*, EMS AB, Stockholm Sweden.
- Dutschke, M. (2006). Risk and Chances of combined Forestry and Biomass Projects under the Clean Development mechanism CD4CDM working paper series working paper No.1: pp1-22.
- Erickson, P.A. (1994). *A Practical Guide to Environmental Impact Assessment*. New England Research, Inc. Worcester, Massachusetts. 266p.
- Essaghah, A.A.E. and E.C. Adibe (1999). *Environmental Impact Assessment in Nigeria, Vol. 2 Principles, Procedures and Practice*. Immaculate Publications Ltd, 182p.
- IPCC (2007). *Fourth Assessment Report: Climate Change 2007, The Physical Science Basis*. Cambridge University Press, Cambridge, UK. 104p
- ITTO Tropical Forest Update (2001). *The process of further processing*. Vol. 11(1):1-7.
- ITTO Tropical Forest Update (2002): *ITTO funds secondary forest management, certification*. Vol. 12(4): 20-21.
- Kenneth, A.K. (2002). *Lumber Recovery Studies of Alaska Sawmills U.S. Department of Agriculture Pacific Northwest Research Station* 333 S.W., 18p.
- Larinde, S.L. and L. Popoola (2008). *Forest Industry Climate Change and Green House Abatement: In L. Popoola (eds) Climate Change and Sustainable Natural Resources Management, Proceedings of the 32nd Annual Conference of the Forestry Association of Nigeria held in Umuahia, Abia State, Nigeria*. Pp267-273.
- Lensile, A.I. (1980). *Logging Concession Food and Agriculture Organization (FAO) International Journal of Forestry*; Vol. 32 No. 129.
- Lucas, E.B. (1983). *Factors Preventing Wider Commercialization of Nigerian Trees*. *Forest Products Journal* 33(5):64-68.
- Lucas, E.B. and A.O. Olorunnisola (2002). *Wood Processing and Utilization in Nigeria: the Present situation and Future Prospects. Proc., Nigerian Institute of Industrial Engineers Productivity Conference*, Vol. 1: 98-109.

- Magelli, F., K. Boucher, T.B. Hsiaotao, S. Melin and B. Bonoli (2009). An environmental impact assessment of exported wood pellets from Canada to Europe. *Biomass and bio-energy* 33: 434-441.
- Ogunsanwo, O.Y. (2001). Effective Management of Wood Waste for Sustainable Wood Utilization in Nigeria. Paper presented at the 27th Annual Conference of the Forestry Association of Nigeria held at Abuja, 17th- 21st Sept. 2001, Pp 226-234.
- Ogunsanwo, O.Y., A.A. Aiyeloja and G.S. Filani (2005). Assessment of Off-Site Waste associated with Timber Flitching in Ibadan, Nigeria. *Proceedings of the 30th Annual Conference of the Forestry Association of Nigeria held in Kaduna State, 7th-11th of November, 2005*. Pp 335-342.
- Olorunnisola, A.O. and D.O. Oyelami (1997). An appraisal of the Sawdoctoring Personnel and Facilities in Selected Sawmills in Ibadan, Oyo State. *The Nigerian Journal of Forestry* 27 (1): 28-31.
- Olorunnisola, A.O. and E.B. Lucas (2005). Sustainability of Forest Industries in Nigeria: A Case study of Ebute-Metta Sawmills, Lagos State. *Proceedings of the 30th Annual Conference of the Forestry Association of Nigeria held in Kaduna State, 7th-11th of November, 2005*. Pp 304-312.
- Onefeli, A.O. (2009). Effect of Mill Size on *Gmelina arborea* Lumber Recovery in Selected Sawmills in Ondo and Ogun State, Nigeria. A final year Project submitted to the Department of Forest Resources Management, University of Ibadan. 41p.
- Onosode, A.T. (1988). Forest and Forest Industries in Nigeria. *Obeche*, 22:27-30.
- Patrick L. and G. Jean (2007). Further Processing of Timber in Central Africa. *Tropical Forest Update*, vol. 17 No.2, pp 7-10.
- PREGA (2004). Utilization of wood waste generated from sawmill operated by smallholder distributed in central Java province. Draft final Report, Pp28.
- Popoola, L. and J.A. Akande (2001). An Integrated Approach to Forestry Sector Impact Assessment (FSIA) in Nigeria. *JTFR* 17(2): 42-57.
- Popoola, L. and T.A. Adebuseye (2002). Economic analysis of parquet production in Nigeria. *Nigerian Journal of Science* 36(2): 141-148.
- Sanwo, S.K. (1981). Wood utilization in the small scale sawmilling industry in Nigeria. Paper presented at the 11th annual conference of FAN, Akure. 23-27 November, 1981. 15Pp.
- Sanwo, S.K. (1982). Wood utilization in the small scale sawmill in Nigeria. *The Nigerian Journal of Forestry* 27(1): 55-57.

Thomas, M.L. and F.H. Jackson (2004). Statistical Methods in Agricultural Research. Pp181-190.

UNIDO (2000). African industry and climate change proceedings. 198Pp.

WBG, (2007). Environmental, Health, and Safety Guidelines for Sawmilling & Manufactured Wood Products, 16Pp.

Winjum, J.K. (1998). Forest harvests and wood products: Sources and Sinks of atmospheric carbon dioxide. Forest Science, Vol. 44, No.2: 272-284.