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DEVELOPMENT OF MILLING ANCILLIARY COMPATIBLE WITH TWO-STROKE POWER SAW ENGINE FOR SHORT LOG CONVERSION

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ABSTRACT

Chainsaw milling is an inevitable means of preventing quantum wastage of valuable and scarce wood resource in un-accessible locations. Milling attachment (MA) was developed for a two stroke power chainsaw to reduce milling difficulties, risk and wastage. Operators of power-saw (90) were randomly selected and interviewed to elicit information on profile and limitations of chainsaw milling. Milling ancillary was developed for two stoke power-saw engine (T-S-PSE) with power to weight ratio rating and guide bar length of 1.5g/w and 75.0cm respectively. Results showed that only 33.3% had formal training while 65.6% were hitherto either unskilled labourers involved in logging activities or sawmill sawyers. About 57.8% respondents own their machine with about 32.7% of them engaged in log merchandize. The average age on chainsaw milling was 15years and it was a means of livelihood for only about 64.4% of the total respondents. This group of respondents is often engaged throughout the year, worked at both open field and forest reserves in Oyo, Osun and Ogun States. The criteria for service charge include activities, log girth, location and environment. MA suitable for use with the described T-S-PSE for milling 500mm maximum log diameter was developed at the cost of four thousand nine hundred naira (₦4900). The study was able to develop MA compatible with T-S-PSE and with 69% performance efficiency.

INTRODUCTION

As submitted by the Holy Scriptures, tree is an important part of human history (*Suratul-Baqarah* 2:35 - The Al Quran, 1983 and Genesis 2:8 - The Holy Bible, 2001). The scriptures (*Op. Cit*) established that early beings relied on tree for the provision of basic needs. Up till now, wood extracted from tree has found wide applications in human needs. Lucas (2000) reiterates the importance of tree in his submission that "*Treeless Era Will Be A Lifeless Era*". Tree is unique in that every component appears to be useful for man. Adewole (2002) observed that tree has found relevance in round form in the production of wooden poles, posts, struts, round trusses used in rural and farm structures. Thinning stems and tree branches may have proved useful without conversion especially, in rural application.

Stem is the most sought part of tree because of volume of lumber recoverable from it, though, the lumber extraction requires conversion. All kinds of facilities are employed in converting log to lumber including chainsaw. Over 20 million cubic meters of lumber is estimated to be sourced annually for various uses from Nigerian forests (Lucas and Olorunnisola 2002). This volume would unarguably source from forest reserve, plantation and open field. The volume of lumber from plantation in Nigeria

appears negligible due to existence of very few plantations (Udo, 1995). Contrarily, the volume obtaining from areas regarded as open field, in Nigeria, is increasing due to urbanization of hitherto rural areas and the need to reduce pressure on natural forests and plantations (Pasiecznik, 2006). However, there are several constraints to logging activities in open field hence, logs from open field often require in-situ conversion because of inaccessibility, poor topography, need to protect cash crop on the farm land among others (Blackwell and Stewart, 2003; Pasiecznik, 2006). Even there are some circumstances when logs extractable in the forest may be inaccessible due to season and topography. In order to circumvent the myriad of problems hindering easy access to economically viable trees in open field and some forest locations, chainsaw milling becomes inevitable (Grisley, 1998; Blackwell and Stewart, 2003; Pasiecznik, 2006).

Evidences abound that large chunk of the volume of lumber available in various plank market throughout Oyo State and particularly at the markets in Ibadan are products of chainsaw milling. Also chainsaw milling is currently carried out using freehand method (Henderson and Krier, 1997) with two stroke power saw engine. Freehand milling with chainsaw is often characterized with problems like kick back, excessive vibration and out-of-plane-cutting. Apart from the huge waste generation and low lumber recovery caused by freehand milling with chainsaw, is itself cumbersome. Makers of power saw often recommend the mounting of vibration damper. The ultimate aim of this study is to develop a milling ancillary for the commonest power saw used for milling in the study area will minimize the associated limitations to the use of such chainsaw for milling. In addition, development of compatible MA for two stroke power chainsaw engine will improve performance of such engine while also enhance sawn cant recovery from the milling of specified sizes of bolts and billets often generated in open field.

METHODOLOGY

Preliminary survey was conducted to ascertain and document style and type of power saw used for chainsaw milling, difficulties involved and operator demographic in the study area. From ten different locations in Ibadan metropolis and suburb: Egbeda, CRIN, Ido, Bodija, Sango, Moniya, Idi-omo, Awotoye, Lalupon and Temidire; 90 chainsaw operators were randomly selected for interview (participant must have at least one year of practice experience). Five chainsaw milling was observed including the demonstration milling carried out in the Department of Forestry Resources Management, Faculty of Agriculture, University of Ibadan. Instrument used for data collection include oral interview (guided by structured questionnaire) and on-the-spot assessment while the data were analyzed using both descriptive and quantitative statistical tools. Using the dimension of relevant components of the selected power saw engine the following features/parameters of the developed MA were determined. That is, the frame's traveling slot width, end-clamp location, adjust-able post height and frame width, span and weight. The details of the MA design in contained in the appendix. Wood was used for the first phase of fabrication to allow for design

adjustment without material wastage. The MA was fabricated using mainly mild steel at Metal Workshop of the Faculty of Technology, University of Ibadan after making necessary modifications on the fabricated wooden prototype. The fabricated MA was evaluated in conjunction with the University of Ibadan Campus Tree Management Committee Operation Crew.

RESULTS AND DISCUSSION

Demographic Characteristics of Respondents

Analysis of demographic characteristics of respondents with regard to age, gender, educational background, mode of skill acquisition, years of practice and business status are presented in Table 1. Results show that age groups of 20-30 years and 31-40 years had the highest number of respondents. This shows that majority of the respondents are in their active periods and should be able to know intricacies associated and happening about with chainsaw milling in their communities.

Table 1: Demographic Characteristics of Respondents

S/N	VARIABLES	FREQUENCY	PERCENTAGE
	A Age (years)		
1	<20	00.0	00.0
2	20-30	31.0	34.4
3	31-40	40.0	44.4
4	41-50	16.0	17.8
5	>51	03.0	03.3
	B Gender		
1	Male	90.0	100.0
2	Female	00.0	00.0
	C Educational background		
1	No formal Education	08.0	08.9
2	Primary School Education	40.0	44.4
3	Secondary School Education	37.0	41.1
4	Post Secondary Education	05.0	05.6
	D Mode of Skill Acquisition		
1	Apprentiship	30.0	33.3
2	No training	60.0	65.7
	E Years of Practice		
1	1-5	30.0	33.3
2	6-10	29.0	31.3
3	10-15	19.0	21.1
4	>16	12.0	13.3
	F Business pattern		
1	Hired machine to operator	38.0	34.2
2	Owned and operate machine	52.0	57.8
3	Combined operation with log merchandize	17.0	32.7

The inherent high level risk and drudgery involved in chainsaw milling (Pasiecznik, 2006) must have been responsible for making it an exclusive job of male in the study area. Most of the respondents (90.1%) had formal education; about 9.9% had no formal education, while post secondary school certificate holders were the least in

number. It depicts that the respondents should be very knowledgeable about the information supplied and can as well be easily trained on how to use ancillary attachment with power saw in chainsaw milling.

Investigation revealed that only 33.3% of the total respondents were formally trained. The rest (65.7%) were either unskilled labourers hitherto involved in logging activities or bandmill operators. About 57.8% respondents owned the power saw engine used for the sawing operation and about 32.7% of respondent in this group also engaged in log merchandize. The implication is that chainsaw milling is thriving, profitable and could sustainably provide a livelihood. The distribution of year of practice is bottom heavy with about 65% respondent within 10 years of experience as at January, 2010. This shows that chainsaw milling job in the study area has in the last one decade been attracting practitioners. The high cost of acquiring the conventional CD4 bandmill, unstable electricity and cost of running sawmill operation must occasioned by Nigeria economic inflation may have been responsible for increased number of chainsaw milling operators in the study area and perhaps all over the country. About 64.4% of the respondents derived their means of livelihood from practicing as operators. This group of respondents is often engaged throughout the year.

Status of Chainsaw Milling in Ibadan and Environs

On-the-assessment of lumber stock in the plank markets in the areas where the power saw operators were selected shows that lumber emanated from chainsaw milling "*Lamole*" outnumbered the product from sawmill. This shows that chainsaw milling is still largely thriving in Ibadan and environ. More than half of the operators interviewed (64.4%) are often engaged to work at both open field and forest reserves located in Oyo, Osun and Ogun States. This suggests that chainsaw milling is relevant in accessing and exploiting some economically relevant wood resource in these states and perhaps throughout the South-western part of Nigeria. In all the study locations the cost of hiring power saw for use for the purpose was #1,500 per day while it will cost a minimum of #4,500 to hire an operator with his power saw machine per day as at February, 2010. However, the ultimate service charge is dependent on several criteria ranging from intensity of activities, log girth, location/environment involved.

Attribute of Chainsaw Milling at the Study Location

Freehand milling method is still being practiced and it is largely associated with huge waste, considerably drudgery and inherently risky. This corroborated earlier finding by Udo (1995); Wyatt (1996); Grisley (1998); Otoo (1998); Muthike (2002); Pasiecznik (2006). Lumber recovery from chainsaw milling is low but useful in converting logs with small diameter as small as 250mm (Hoadley, 2000). It is particularly common in the emerging settlements at the study area for logs (mostly less utilized tree species including fruit trees) harvested from plots of land marked for development and hitherto farms to be exclusively milled using chainsaw. The commonly used chainsaw in the study area is the petrol driven type of two-stroke

engines of 680 STHIL model. The rear handle type of two-stroke engines has a great power-to-weight ratio. It varies in guide bar lengths and the general rule is to choose a chainsaw with the shortest guide bar suitable for the work. Formal training on how to use this chainsaw for various jobs especially milling is emphasis by the producers (Health and Safety Executive, 2007).

Milling Ancillary Design and Fabrication

The features/dimensions of the chainsaw that the milling ancillary was developed for are presented in Table 2. The power to weight ratio of the machine used for the design is 1.5g/w. To conserve material, minimize weight and to guarantee frame rigidity, the following parameters and assumptions were considered:

- Chainsaw weight = 750kg
- Chainsaw Length = 400mm
- Chainsaw Breadth = 300mm
- Chainsaw Height = 300mm
- Yield strength of steel (S_h) = 250Mpa (Ryder, 1978)
- Width of the member (W) = 600mm
- Horizontal shearing stress for timber (G_h) = 3.75×10^6 Mpa

Table 2: Features of MS 650 STIHL Magnum™ Chainsaw for which the Milling Attachment was Developed

S/N	Component Description	Dimension/Rating
1	Power head weight	750g
2.	Guide bar length	400mm
3.	Machine Width	600mm
4.	Machine Height	300mm
5.	Bumper spike length	150mm
6.	Displacement	84.9cc
7.	Engine power	4800w
8.	Fuel capacity	825cc
9.	Chain oil capacity	360cc
10.	Saw chain	#3624/33 RSC3 84

The materials to be used are expected to be able to resist corrosion, light in weight, rigid, stabile, be cost effective and readily available. Each rail was designed to have the same depth to ensure uniformity. Detail design is presented in the appendix however frame dimensions were estimated from equation 1and sketch presented in Figure 1.

$$S_h = \frac{G_h}{WD} \quad \text{------ (1) (Ryder, 1978)}$$

Where, Depth (D) = **25mm** (Other parameters were as defined above)

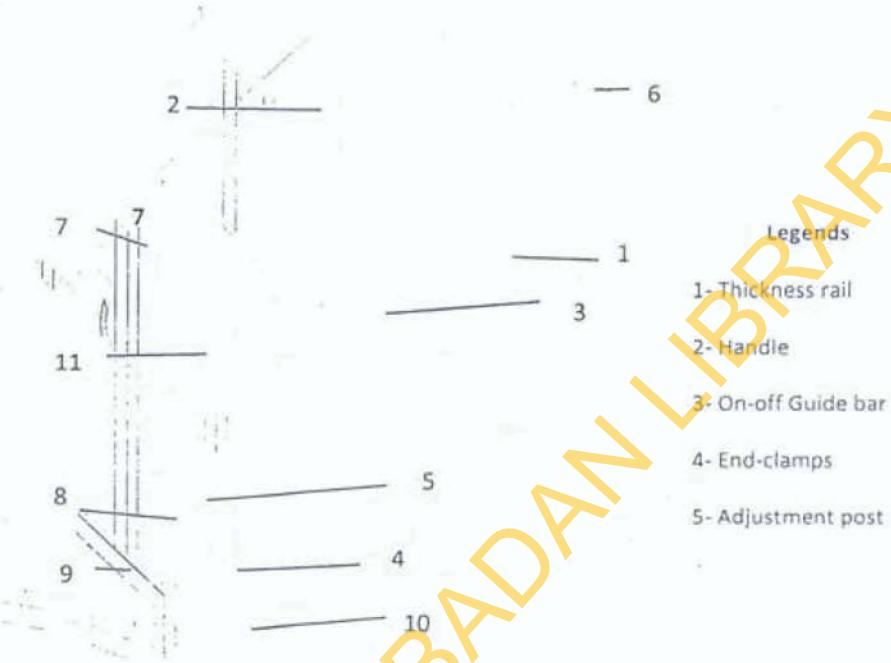

Figure 1: Milling Ancillary

The frame dimensions are:
- Frame length = 600mm
- Frame width (by adding 50mm clearance on both sides to the power saw machine width) = 400mm
- Frame adjustment post (consisting calibrated post, end clamps and connector plate) = 300mm
- End clamp width (with clearance of 50mm on both sides for the cutting bar) = 200mm
- Slot clearance between the clamps = 50mm

In order to save cost and to minimize material waste during fabrication, wooden prototype was first produced using *Gmelina arborea* wood before fabricating the original ancillary after making necessary modification to the wooden prototype shown in Plate 1. The cost of producing the prototype milling ancillary shown in Plate 2 as at February, 2010 was four thousand nine hundred naira only (₦4900.00).

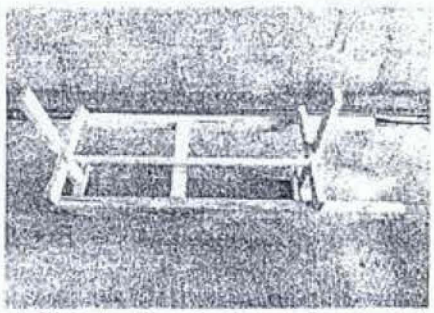

Plate 1: The Miling Ancillary Prototype Constructed with Wood

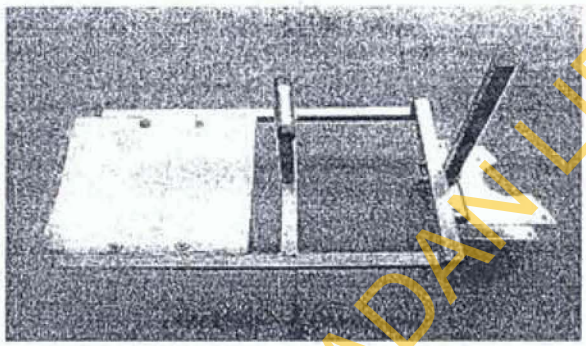

Plate 2: The Fabricated Milling Ancillary

Evaluation of the Milling Ancillary

Evaluation of the chainsaw milling ancillary was carried out in conjunction with the operation crew of the University of Ibadan Campus Tree Management Committee (Plates 3 and 4). Experience during the first round of test shows the need to train would be operator on machine positioning (Plate 3) when milling for safety reasons. The operator was guided on how to use, the guidance reflected on the subsequent cutting as it became easier for the operator and the performance efficiency rating of the milling exercise was 69%. This efficiency will increase if the log to be milled is supported on a stand and if the use is restricted to converting billets and short logs cut from small girth tree, especially short logs with diameter not more than 500mm.

Plate 3: Author Guiding the Operator during Trial Milling using the Developed Attachment

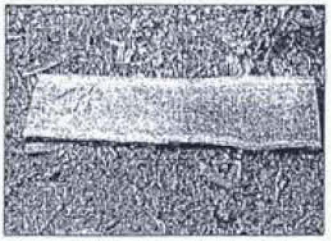

Plate 4: Sample of the Product from Chainsaw Milling using the Developed Ancillary

CONCLUSIONS

This study shows that chainsaw milling is still one of the processes used in log conversion in Ibadan and environs. The business of chainsaw milling provides means of livelihood to the practitioners while majority of the operators were between 20 to 40 years of age. Large number of the operators had no formal training on chainsaw milling but rather acquired skill on job. Operators in the area worked at both open field and forest reserves in Oyo, Osun and Ogun States and criteria for service charge include activities, log girth, location and environment. The commonest power saw engine currently used for chainsaw milling are used without guide and freehand method is still been used. The study further confirmed that drudgery, risk and huge material are associated with the process. A milling attachment suitable for use with two-stroke power saw engine was developed. The prototype cost four thousand nine hundred naira (₦4900) as at June 2010 and it has 69% performance efficiency. Material wastage, risk, vibration and other difficulties involved in chainsaw milling were considerably reduced when the ancillary guide was used with a chainsaw during testing.

It is however recommended that when cutting the first slab there must be clearance between the surfaces of the frame of the milling ancillary and the log to be converted, so that there will be no obstruction due to the irregular cross-section of the log during milling operation. Also the milling attachment is more suitable for converting short log of 500mm maximum diameter.

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