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ASSESSMENT OF WOOD WASTE GENERATION AND UTILIZATION IN MAKURDI METROPOLIS: IMPLICATION FOR SUSTAINABLE MANAGEMENT OF FOREST RESOURCES

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ABSTRACT

This study assessed forest waste generation and utilization in Makurdi metropolis. The increasing quantities of wood wastes from timber sheds, furniture industries and chainsaw millers possess a threat to the sustainable management of forest resources and environmental sustainability. Descriptive statistics such as frequency, mean, percentages and tables, were used to analyze the result. A five-point Likert scale was used to determine the level of utilization of wood wastes. The findings of the study revealed three major sources of wood waste which were: timber sheds (37.8%), furniture factories (33%) and chainsaw millers (29.2%) while the types of wood wastes include: sawdust (14.9%), wood chippings (12.8%), wood shavings (21.1%), offcuts (20.2%) and trims (21%). Generated wood wastes were utilized as: animal beddings (39.4%) mulching (28%), generation of household energy (22.7%) briquettes production (6.0%) and engineered wood production (3.9%). The result on the level of utilization of wood waste indicated that it was low with Weighted Mean Score (WMS) of 1.9042. Lack of awareness (55.9%) was the most limiting factor of wood waste utilization followed by lack of technical know-how (18.6%), lack of start-up capital (25%) while the least limiting factor was inadequate raw material (0.5%). This study therefore concludes that the level of utilization of wood waste in Makurdi metropolis was very low. It is therefore, recommended that policy measures or incentives should be provided to wood merchants to encourage investments into utilization of wood wastes in Makurdi metropolis.

Keywords: Wood waste, Wood generation, Wood utilization, Sustainable management

INTRODUCTION

Wood waste generation in Nigeria is constantly increasing due to factors such as low average timber recovery both in the forest and wood processing industries (Akhaton *et al.*, 2017). The activities at forests, wooded lands, and wood processing industries generate a huge volume of wood wastes that could be harnessed to produce value added products. With the loss of 55.7% of Nigeria's primary forest, the annual rate of

deforestation is approximately 3.7%, which is between 350,000 and 400,000 hectares per year and one of the highest in the world. Between 1990 and 2015, Nigeria lost about 35% of its remaining forest resources and over 50% of other wooded lands (Balarabe, 2011; Sambe *et al.*, 2018).

These wood industries include; sawmill industries, plywood mills, furniture industries, pulp and paper industries and particleboard mills (Mijinyawa *et al.*, 2010).

According to Ogunwusi (2014), sawmills generate a huge amount of wood wastes which accounts for 93% of wood wastes through processing logs of wood into lumbers of various forms and sizes in the mills. These wood wastes including sawdust, slabs, bark, split wood, etc. are generated during this process. Although sawmills are the largest sector of wood processing in Nigeria, wood wastes are also generated from other wood processing industries, like the furniture industries, plywood mills, and particleboard mills and also generated from municipal and industrial activities.

Sambo (2009) estimated the amount of sawdust generated per annum in Nigeria to be about 1.8 million tons, while Francescato *et al.*, (2008) reported a figure for wood residues to be about 5.2 million tons per year. Ogunwusi (2014), reported that less than 40% of wood taken out of the forest is used at an industrial level with the rest been disposed as waste while less than 5% of the wood wastes is utilized. This makes the current pattern of industrial wood utilization unsustainable and a threat to the ability of the forest estate of the country to sustain the wood industry.

Due to poor management methods, these vast amounts of wood residues are often discarded as useless materials, usually untreated, into the environment where they cause adverse effects. Disposal methods such as heaping at industrial sites, dumping on roadsides, drainages or water bodies and open-air burning are common practices. The residues are often dump into rivers by wood industries that are situated close to river banks. These indiscriminate disposal practices result in untoward environmental and human impacts; unsightly look of the environment, air pollution, respiratory tract infection, eye problems, contamination of rivers and ground waters, also it results to the distortion of water ecosystems and climate change (Arimoro *et al.*, 2007; Nwankwo, 1998; Wihersaari, 2005). Wood wastes residues are a common feature in wood industries

throughout the year. According to Owoyemi *et al.* (2016) these residues have led to practices such as open incineration, dumping in water bodies or in open areas that constitute environmental pollution which affects both the aquatic and terrestrial ecosystems and also its burning releases greenhouse gases into the atmosphere causing various health problems. Owoyemi *et al.* (2016) reported that sawmill alone generated 1,000,000 m³ of wood waste in 2010 while about 5,000m³ of wood was generated in the Plywood industries in Nigeria. The increasing consumption of wood also poses a threat to the survival of wood industries since harvested trees are not replaced or planted. This affects the sustained supply of raw materials for the industries.

The proper utilization of wood wastes through reuse and recycling will reduce pressure on the ever-decreasing forests, reduce environmental pollution and create wealth and employment and thereby, foster economic development of the country.

These wood wastes disposal practices contradict sustainable solid waste management which entails various activities that encourage the efficient utilization of material resources to reduce the amount of waste produced and the management of waste generated in such a way that the economic, social and environmental goals of sustainable development are largely achieved (Pianosi, 2012). According to (International Institute for Sustainable Development, 2016), sustainable development is a development that satisfies the needs of the present generation without jeopardizing the ability of future generations to meet their own needs. Using recycled resources in production processes instead of new materials usually results in less consumption of energy and original materials, less waste landfilled, and less Green House Gas (GHG) emissions over a product's life cycle. To ensure sustainable management of these wood wastes, they must be harnessed or utilized for the production of useful by-products for economic growth and

sustainable management. Hence, this research aims at identifying the sources and types, levels of utilization as well as factors limiting the utilization of wood wastes in the study area. This study therefore sought to identify the sources, types of wastes and determine the ways of utilization, level of utilization and factors limiting utilization of wood wastes in Makurdi metropolis.

MATERIALS AND METHOD

Study Area

Makurdi is the capital of Benue State and is located in the middle belt region of Nigeria. It is situated on latitude 7° 44'1.50'' N to longitude 8° 31'17.00''E situated 100 m above sea level along the Benue Riverbank. Makurdi Local Government was created on the 3rd of February, 1976 but was founded about 1927 when the railroad from Port Harcourt (279 miles (449km) south-southwest) was extended to Jos and Kaduna (Chia and Ugwuishiwu, 2014).

The town is naturally divided into two landmasses by River Benue into North and South Banks. Makurdi has a typically tropical climate with a clearly distinct dry and rainy season. The dry season commences from November to March while the rainy season starts from April and ends in October. Temperature fluctuates between 23 °C during the rainy season to as much as 38 °C during the dry season (Tyubee, 2009).

The vegetation consists of Guinea Savanna forest of open woodland with tall trees as well, usually with short bole and broad

Table 1: Sampling Layout

Wood wastes source	No. of workers	Sample size
Timber shed	255	71
Furniture factories	160	62
Chainsaw millers	120	55
Total	535	188

Data Collection

Data was collected from primary and secondary sources. The primary sources included reconnaissance surveys, questionnaires, and personal observations.

leaves. In 2006, Makurdi had an estimated population of 300,377 National Population Commission (NPC, 2006)

Population and Sampling Procedure

The study population comprised of wood industry enterprises in Makurdi metropolis. A reconnaissance survey was carried out and wood industries in the study area were identified. Purposive sampling and random sampling techniques were used to determine the study sample drawn from wood processing industries in Makurdi metropolis.

The respondents for the study were drawn from timber sheds: Indigenous timber shed (45), North bank timber shed (55) and Central timber shed (155)], Furniture factories (Max Woody Tech (115), Trust in God Furniture Ltd. (30) Clusters of furniture areas in Wurukum (20)]. Complete enumeration was used to sample furniture factories while simple random sampling was used to sample respondents from timber shed and chainsaw millers.

Thus, a sample size of 188 respondents was obtained from the three wood waste sources using the Taro-Yamane formula to get the sample size. Taro-Yamane formula is expressed as:

$$n = \frac{N}{1 + N(e)^2} \dots\dots [1]$$

Where: n=corrected sample size
 N= population size,
 e=margin of error.

Semi-structured questionnaire was designed and administered to furniture factories staff, timber shades staff, and chainsaw millers to elicit information for the study.

Data analysis

Statistical tools were used to analyse the data. Descriptive statistics such as frequency mean and percentages, tables, frequency distribution were used to achieve the objectives of the study.

Determination of level of utilization

Five-point Likert scale rating format as used by Dagba *et al.*, (2017) was adopted to analyze the level of utilization of wood waste in the study area. The weighing scale was derived from the following values with respect to the level of wood waste utilization; Very High (VH) = 5, High (H) = 4, Moderate (M) = 3, Low (L) = 2, Very Low (VL) =1.

The Likert rating Mean Score (MS) of the level of wood waste utilization was expressed as:

$$MS = \frac{\sum f}{n} \dots [2]$$

Where:

f = Summation of the five-point rating scale and

n = Number of points

Therefore, for a five-point Likert scale, MS is expressed as:

$$MS = \frac{1 + 2 + 3 + 4 + 5}{5} ; MS = 3.0 \dots [3]$$

The Likert Weighted Mean Score (WMS) of the level of wood waste utilization was

$$WMS = \frac{\sum_{i=1}^n f_i x_i}{N} \dots [4]$$

Where:

f = frequency of respondent

x = Likert scale point

N= Total Number of respondents

Using the interval scale of 0.05, the Upper Limit (UL) cut-off is MS+0.05 (3.0+0.05 = 3.05). The Lower Limit (LL) cut-off is MS - 0.05 (3.0-0.05 = 2.95). Based on these two extreme limits any variable with WMS below 2.95 (WMS<2.95) was considered 'Low'. Variable with MWS between 2.95 and 3.05, 'Moderate' any variable MWS greater than 3.05 (MWS>3.05), 'High'.

RESULTS

Demographic Characteristic of the Respondents

The result of the demographic characteristics of respondents is presented in Table 2. The result indicates that the majority of the respondents were male (92.6%), the age group between 31-40 years were dominant (77.7%) in the age distribution. About 89.4% of the woodworkers were aged below 45years of age. Based on marital status, a greater proportion of the respondents (60.1%) were married while (39.9%) were single.

In terms of educational level, 66% of the respondents had secondary education, 26.1% had tertiary education while 7.4% and 0.5% had primary and non-formal education respectively.

The income distribution of respondent shows that 31.4% of the respondents dominated with annual salary of N360, 000 while the least proportion of the respondents was (0.5%) earned N1, 800, 000 per annum.

Table 2: Social-economic Characteristics of the Sample Population in Makurdi Metropolis

Characteristics	Category	F(n=188)	Percentage (%)
Marital Status	Single	75	39.9
	Married	113	60.1
Gender	Male	174	92.6
	Female	14	7.4
Age	15-20	1	0.5
	21-30	21	11.2
	31-40	146	77.7
	>40	20	10.6
Level of Education	Non-Formal	14	7.4
	Primary	1	0.5
	Secondary	124	66.0
Major Occupation	Tertiary	49	26.1
	Laborer	122	64.9
	Trading	66	35.1
	240,000	54	28.7
	300,000	11	5.9
	360,000	59	31.4
	600,000	1	0.5
Estimated annual income	840,000	55	29.3
	960,000	1	0.5
	1,200,000	6	3.2
	1,800,000	1	0.5

The result of the sources of wood wastes is presented in Table 3. The result revealed that the highest (37.8%) proportion of wood wastes comes from timber shades, followed by furniture factories (33%) and then, chainsaw mills (29.2%). Hence, indicating the major sources of wastes generation in the study area.

Types of wood wastes in the study area

The types of wood wastes in the study area are presented in Table 4. The result indicated that wood shavings (21.3%) and trims (21.0%) were the major types of wood wastes generated in the study area. This is followed by offcuts (20.2%), sawdust (14.9%), wood chippings (12.8%), while branches (9.8%) were the least type of wood wastes generated in the study area.

Table 3: Sources of wood wastes in Makurdi metropolis

Sources	Frequency	Percentage (%)
Furniture Production	62	33.0
Timber shed	71	37.8
Chainsaw mills	55	29.2
Total	188	100

Table 4: Types of wood wastes in Makurdi metropolis

Wood wastes	F(n=564)	Percentage (%)
Sawdust	84	14.9
Offcuts	114	20.2
Wood Chippings	72	12.8
Branches	55	9.8
Wood Shavings	120	21.3
Trims	119	21.0
Total	564	100

Ways of wood wastes utilization in the study area

The result on ways of utilization of wood wastes is presented in Table 5. The result revealed that the highest proportion (39.4%)

of wastes is used for animal beddings, 28% for mulching gardens, 22.7% for energy use, while the least uses were for briquettes making (6%) and production of engineered wood products (3.9%).

Table 5: Ways of wood wastes utilization in Makurdi metropolis

Usage of wood waste	F(n=282)	Percentage (%)
Briquettes making	17	6.0
Energy use	64	22.7
Engineered wood products	11	3.9
Animal beddings	111	39.4
Mulching gardens	79	28.0
Total	282	100

Level of Utilization of Wood Wastes in Makurdi Metropolis

The result of the Likert scale on the level of wood wastes utilization is presented in Table

6. The WMS of 1.9042 indicates that the level of utilization of wood wastes is low in the study area.

Table 6: Likert scale result on the level of utilization of wood wastes in Makurdi metropolis

N	M	L	VL	WS	WMS	Remark
188	30(90)	110(220)	48(48)	358	1.9042	Low

Factors Limiting the Utilization of Wood Wastes in the Study Area

The result of factors limiting utilization of wood wastes is presented in in Table 7. The result indicated lack of awareness (55.9%) as the major factor limiting wood wastes

utilization, followed by lack of capital (25%), technical know-how (18.6%) while inadequate raw material (0.5%) was recorded the least factor limiting wood waste utilization in the study area.

Table 7: Factors Limiting the Utilization of Wood Wastes in Makurdi Metropolis

Categories	F(n=188)	%
Lack of capital	47	25.0
Lack of awareness	105	55.9
Inadequate Raw material	1	0.5
Lack of Technical Know-how	35	18.6
Total	188	100

DISCUSSION

Wood industries in Makurdi employ people of different age groups with the male gender dominating the industry. The reason for the male dominance is due to the nature of tediousness of the work which limits women participation. This agrees with Rongo *et al.*, (2005) who reported that the dominance of the male population and a young workforce in wood industries is due to the tedious operations of the industry which discourage most women from engaging in the enterprise. The fact that majority of the respondents fall within the active age distribution of 31-40 years further justify the above claim. A larger proportion of them were married, which implies that the industry is perhaps a secured livelihood activity in the study area.

The relatively larger proportion of literate respondents implies that the industry requires a degree of literacy due to measurements and simple calculations involved in wood processing (Aiyelaja *et al.*, 2012). The respondents could also be more amenable to development policies required to be implemented.

The generation of wood waste from sawmills, timber shades, furniture industries, and plywood industries is also reported by Ajanaku, (2004); Ogunwusi, (2012); and Ademola-Aremu *et al.*, (2009). They also posited that those sources of waste generation are common in Nigeria.

According to Ekhuemelo and Atongo, (2015) timber sheds are the highest generators of wood wastes in Makurdi metropolis since the decline of sawmill operations in Makurdi due to difficulty of obtaining raw materials.

Wood wastes found across wood industries include, sawdust, wood offcuts, wood backs, plain shavings, wood rejects, all generated during wood processing in timber shades. Wastes such as off-cuts, trims, wood shavings, and wood chips are produced in the furniture industries. While branches and trims are generated in the chainsaw mills. This agrees with (Owoyemi *et al.*, 2016) who

reported the above wood waste as the common wastes generated in wood industries in Nigeria.

The reason for the highest proportion of wood wastes been used for animal bedding and mulching stems from the fact that wood wastes are underutilized and rarely utilized for biofuel production, briquettes, particle boards, and engineered products. This corroborated the findings of Akhator *et al.*, (2017) who reported that due to lack of technical know-how and investment in the sector, animal bedding and garden mulching are the common ways by which wood wastes are utilized in Nigeria. He further stated that only 5% of the total waste generated is utilized in the country.

The level of wood waste utilization in the study area is very low, the reason is that most of the waste goes to animal beddings and mulching which accounts for just a little percentage of the total wastes generated. Ogunwusi (2014) reported less than 5% utilization of the total wood waste generated in Nigeria, which leaves a huge quantity of wood waste unutilized.

One of the major problems limiting high-level utilization of wood waste in Makurdi is that no concrete effort is made to incorporate fuel burners into the wood processing companies. This leaves a huge quantity of wood waste unutilized (Kukogho *et al.*, 2011). This is because wood waste handling, processing and combustion requires higher capital outlay, considerable development in new and imported technology and plant design. The findings by Ogunwusi *et al.*, (2014) also corroborates the fact that the lack of incentives for wood waste utilization, inadequate information on economic returns on wood waste utilization, poor enforcement of environmental regulations, absence of policies targeted at wood waste management, lack of technical know-how on wood waste processing and utilization, among others are challenges facing the wood industry. This implies that wood wastes are hardly utilized in the study area due to factors such as lack of capital to set up and technical know-how.

Conclusion

The level of wood waste utilization in Makurdi metropolis is very low as most of the waste goes to animal beddings and mulching which accounts for just a little percentage of the total wastes generated.

Based on findings from this study, one of the major problems limiting high-level utilization of wood waste is lack of awareness of reuse values of wood wastes. Apart from using waste for animal beddings, there is a low awareness on the various ways of utilizing wood waste in Makurdi metropolis.

Recommendations

- i. Fuel burners should be incorporated into the wood processing companies so as to use these wastes for biofuel
- ii. The use of modern equipment for wood processing should be

encouraged as this would help in minimizing the volume of wastes generated.

- iii. Awareness should be created by government and non-governmental organizations to users on the ways of utilizing wood wastes and policies should be enacted to help people adopt.
- iv. The reuse/recycling technologies of waste wood should be encouraged by government as a source of wealth for small and medium-sized industries.
- v. Further research should be done on the discovery of new and innovative methods of wood waste utilization by universities and other research institutions.

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