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ASSESSMENT OF WOOD WASTE GENERATION AND UTILIZATION: IMPLICATION FOR INDUSTRIAL DEVELOPMENT IN WUKARI, TARABA STATE

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Abstract

The manufacturing industry is a significant element of high-quality economic development with its productivity growth potential higher than that of many other industries. However, one of the factors affecting industrial development is availability of raw materials. There are many timbers related activities in Taraba state which generate high quantity of wood waste and forest residues, which can serve as raw materials for wood-based industries. Hence, there is need to determine the factors responsible for poor wood-based industrial development despite the presence of abundant raw materials and human resources in the study area. A self-administered questionnaire survey method was used for data collection. Descriptive statistics was used to analyze the results. A five-point Likert scale was used to determine the level of utilization. The findings of the study shows that the generated wood wastes were utilized mainly for: energy generation for cooking (38.41 %), animal bedding (29.27%), plant mulching (23.17%) and local building materials (6.71%), while the least uses were for production of engineered wood products (1.83%). The result on the level of utilization of wood waste indicated a low level with Weighted Mean Score (WMS) of 1.9. Lack of awareness (70%) was the most limiting factor of industrial utilization of wood waste followed by lack of technical know-how (23%) and lack of start-up capital (6%). Conclusively, the major problems limiting high-level utilization and industrial application of wood waste is lack of awareness of reuse values of wood wastes and lack of technical-know-how.

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1. Introduction

The manufacturing sector is regarded as one of the pillars for economic expansion and represents the most essential contributory sector in developing countries. Lechuga et al. (2021), stresses the need to identify gaps and provide recommendations to enhance the sector's possibilities for sustained growth. To be relevant, the manufacturing sector must have the ability to harness the various available raw materials, process and transform them into marketable finished or partly finished goods through the use of human capital and other factors of production. The finished goods in turn contribute significantly to the national GDP and create income and employment opportunities for the citizenry of that nation (Sokunle and Harper, 2016). Among the raw materials that are readily available in the study area and can contribute greatly to the manufacturing sector are wood waste and forest residues.

The possible use of wood waste and forest residues are often severely limited by difficulties in handling and segregating them, or by their non-adaptability to the consumer's needs or to his manufacturing processes (Kaushal et al., 2012). Furthermore, wood residues may be of such form, condition, or species that serious technical difficulties preclude their use for regular product with regular equipment (Vassilev *et al.*, 2013). However, forest residues and wood waste have found application in some industries which include the energy industries, construction, pulp and paper industries, wood-based panel industries and agricultural industries (Martinez et al., 2018; Sullivan, 2016; Foltz, 2012; Duncker et al., 2012).

In Nigerian wood-based industries includes timber logging, sawmilling, furniture making, match production and the manufacture of several wooden items such as tools handles, sport goods, handicraft equipment and toys (Sekumade and Oluwatayo, 2011). The wood-based industries generate lot of unwanted, or used product (waste) from tree cut-offs, sawdust, tree barks etc. and this waste has become prominent due to the high demand for timber and its derived products (Kizha and Han, 2015; Jørgensen and Pederson, 2018). The produce residues most be utilized or properly disposed-off. Heaps of wood residues are common feature in wood industries throughout the year and these residues are not adequately utilized to satisfy the countries bio-resources and industrial needs (Kaushal et al., 2012). These wood residues, if not properly utilized, have various consequences on the environment and on human health (Dinnes et al., 2002; Owoyemi et al., 2016). On the other hand, proper utilization can lead to reduced deforestation and economic generation (Martinez-Pastur et al., 2020; Allegret et al., 2020). However, the industrial utilization of forest residues and wood waste will depend on the knowledge and technical know-how of timber operators in the area.

Therefore, there is need for study on forest waste utilization in Nigeria in general and in Taraba state in particular in order to access the knowledge and technical know-how of local timber operators on industrial utilization of forest residues and wood waste and factors mitigating against establishment of wood waste-based manufacturing industries.

Underutilization of forest Residues and wood waste translates to economic loss as resources are spent on growing of timber and other silvicultural activities. Thus, unutilized forest residues and wood waste translates to loss of economic resource spent on timber plantation. Additionally, purchasers of timbers buy timber in whole - the sawdust and other conversion waste are paid for. Therefore, when there is unutilized waste, the resource used in the purchase and transportation becomes economic loss.

Despite the availability of raw materials - wood waste, there is little industrial presence in the study area to utilize the raw materials. Thus, this research aimed at finding out the factors responsible for poor industrial development despite the presence of abundant raw materials and human resources and make recommendations for effective industrial development. Thus, an assessment of forest residues and wood waste utilization in Wukari local government area of Taraba state was carried out.

2. Materials and Methods

Methods of Data collection and analysis employed in the research are described in this section.

2.1. Description and Location of the Study Area

The study was carried out in Wukari Local Government Areas of Taraba State Nigeria. Wukari Local Government Area is one of the sixteen Local Government Areas of Taraba State. Wukari town is situated in the southern part of Taraba State. It is situated along Latitude $7^0 52'$; $17''$N to $70 .87'$ N and a longitude $9^0 43'$ $38''$E to $90 .77''$E at an elevation of 189 meters above sea level. Wukari occupies an area of $4,308 km^2$ (Taraba State Government Diary, 2016). Figure 1 contains map of Taraba State showing the study area.
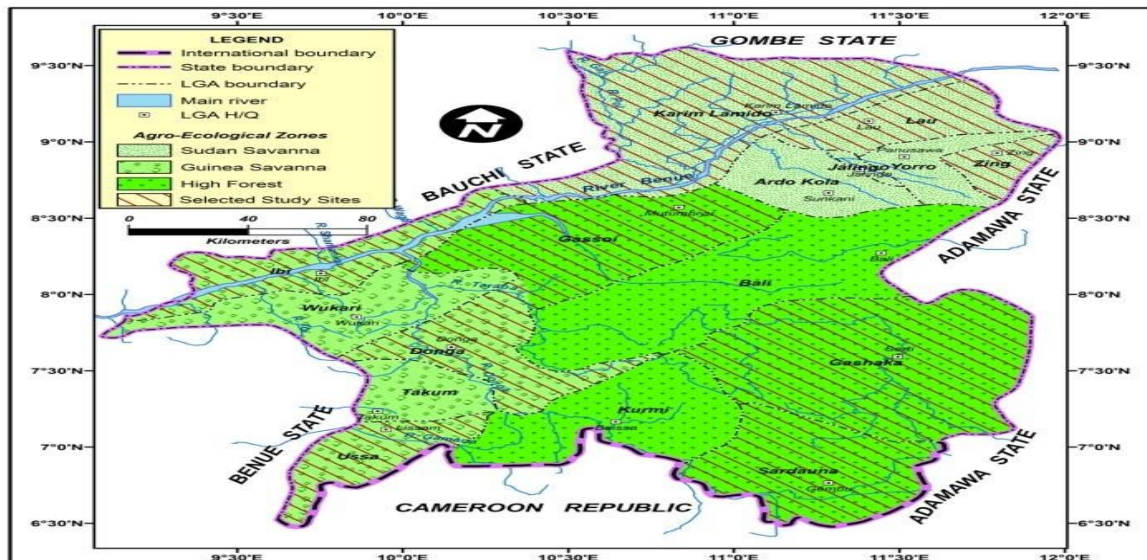

Figure 1: Map of Taraba State showing the study area (Taraba State Government Diary, 2016)

2.2. Method of Data Collection

The data for this research was collected from primary sources. This research adopted a self-administered questionnaire survey method as the strategy for data collection. The use of a self-administered questionnaire instead of a postal or e-mail questionnaire encouraged people to participate fully in the study. The primary data was collected through the administration of semi-structured questionnaires to timber operators. The closed-ended questions were predetermined and gave useful information to support theories and concepts in the literature while the open-ended question was used to explore reasons behind the responses and to obtain more information on the participants knowledge.

2.3. Sampling Procedure

A purposeful sampling strategy was adopted for this study. The purposeful sampling method allowed for the selection of individuals that are information rich and may provide useful information about the central phenomenon. Using 30% sampling intensity, a proposed total of hundred (100) questionnaires was administered in the Local Government Area under study. This number is based on recognizance study on the number of active timber operators in the study areas.

The sampling frame of this study comprises of the timber operators. The unit of analysis required is the individual. The timber operators include sawyers, other sawmill workers, loggers, wood cutters, carpenters/furniture makers and timber marketers.

2.4. Method of Data Analysis

In order to achieve the stated objectives of this research, the methods of data analysis that was used include cross tabulation, frequency distribution and percentage analysis. These types of data analysis were chosen in order to determine the most prevalent wood waste and forest residue in the study area, present most utilization of forest residues and wood waste in the area and knowledge of timber operators on waste and residues industrial utilization among others.

2.5. Determination of Level of Utilization

Five-point Likert scale rating format was used to analyze the level of utilization of wood waste and forest residues in the study area (Dagba et al., 2017). The weighing scale was derived from the following values with respect to the level of wood waste and forest residues 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:

$$MS = \frac{\sum f}{n} \qquad (1)$$

Where: Σf = Summation of the five-point rating scale; and n = Number of points

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

$$MS = \frac{1+2+3+4+5}{5}; MS = 3.0 \qquad (2)$$

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

$$WMS = \frac{\sum_{i=1}^{n} f_i x_i}{N} \qquad (3)$$

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 3.05was considered 'Moderate'. Any variable with MWS greater than 3.05 (MWS > 3.05), was considered 'High'.

3. Results

Results obtained from the research are presented in this section.

3.1. Demographic Characteristic of the Respondents

The result of the demographic characteristics of respondents is presented in Table 1.

Table1: Demographic characteristics of the respondents

Category	Count n=100	Percentage (%)	Variables
Gender	Male	82	82
	Female	18	18
Age Category	15-25Yrs	31	31
	26-35Yrs	46	46
	36-45Yrs	19	19
	46-55Yrs	4	4
Educational Level	Non-Formal	6	6.0
	FSLC	14	14
	SSCE	37	37
	Diploma/NCE	20	20
	Degree	21	21
	Post-Graduate	2	2
Marital Status	Single	40	40
	Married	60	60
	Divorced	7	7
Annual Income in Naira	<100,000	51	51
	101,000-200,000	7	7
	201,000-300,000	9	9
	301,000-400,000	8	8
	401,000-500,000	5	5
	501,000-1,000,000	19	19
	>1,000,000	1	1
Occupation	Sawyer	21	21
	Wood logger	15	15
	Sawmill worker	25	25
	Wood cutter	13	13
	Timber Marketer	25	25
	Others	1	1

The result indicates that the majority of the respondents were male (82%), the age group between 26-35 years were dominant (46%) in the age distribution. About 31% of the woodworkers were aged below 26years of age. While 19% of the respondent were aged 36-45 years. Based on marital status, a greater proportion of the respondents (60%) were married while (40%) were single. In terms of educational level, 37% of the respondents had secondary education, 43% had tertiary education while 14 % and 6% had primary and non-formal education respectively. The income distribution of respondent shows that 19% of the respondents dominated with annual income (in Naira) of 501,000-1,000,000 while the least proportion of the respondents (1%) earned above N1, 000, 000 per annum.

3.2. Types of Wood Wastes and Forest Residues in the Study Area

The types of wood wastes in the study area are presented in Table 2.

Table 2: Types of wood waste and forest residues in the study area

Wood waste	F (n = 202)	Percentage (%)
Bark	15	7.43
Branches	15	7.43
chips	9	4.46
Edging	9	4.46
offcut	30	14.85
Sawdust	80	39.60
Shavings	44	21.78
Total.	202	100

The result indicated that saw dust (39.6%) is the major wood waste generated in the study area. This followed by wood shavings (21.78%) and offcut (14.85%) respectively. The least types of wood and forest residues generated in the study area are barks (7.43%) and branches (7.43%), chips (4.46%) and edgings (4.46%).

3.3. Ways of Wood Wastes and Forest Residue Utilization in the Study Area

Ways of utilization of wood wastes and forest residue in the study area is presented in Table 3.

Table 3: Wood wastes and forest residue utilization in the study area

Usage of wood waste	F (n=164)	Percentage (%)
Animal Bedding	48	29.27
Energy use	63	38.41
Engineered wood product	3	1.83
Local Building Material	11	6.71
Plant Mulching	38	23.17
Traditional Medicine	1	0.61

The highest proportion (38.41 %) of wastes in the study area is used for energy generation, 29.27% for animal bedding, 23.17% for plant mulching, 6.71% as local building materials, while the least uses were for production of engineered wood products (1.83%) and traditional medicine (0.67%).

3.4. Level of Utilization of Wood Wastes in the Study Area

The Likert scale on the level of wood wastes utilization is presented in Table 4. The WMS of 1.9 indicates that the level of utilization of wood wastes is low in the study area.

Table 4: Likert scale result on the level of utilization of wood wastes and forest residues in the study area

N	VH	H	M		L		VL		∑WS	WMS	REMARKS
			f	ws	f	ws	f	ws			
100	-	-	10	30	70	140	20	20	190	1.9	Low

3.5. Knowledge of Timber Operators on General Industrial Uses of Wood Waste and Forest Residues and Factors Limiting the Utilization of Wood Wastes in the Study Area

The knowledge of respondents on industrial application of forest residues and wood waste was assessed and presented in Table 5.

Table 5: Knowledge of respondents on industrial application of forest residues and wood waste

Categories	F (n=110)	Percentage (%)
Briquette	16	14.55
No Idea	68	61.82
Pulp and paper products	4	3.64
Wood based panel products	22	20.00
Total	110	100

The result shows that the majority of the respondents in the study area (61.82 %) has no knowledge of any industrial application of the generated wood waste and forest residues. 20% knows that it can be applied in wood-based panel production, 14.44% knows it can be used for briquette production while 3.64% has the knowledge that it can be used in pulp and paper production.

The result of factors limiting utilization of wood waste and forest residues are presented in Table 6.

Table 6: Factors limiting utilization of wood waste and forest residues in the study area

Categories	F (n = 100)	Percentage (%)
Inadequate Raw material	1	1.00
Lack of awareness	70	70.00
Lack of capital	6	6.00
Lack of Technical-know how	23	23.00

The result (Table 6) indicated lack of awareness (70%) as the major factor limiting wood wastes utilization, followed by lack of technical-know-how (23%), lack of capital (6%), while inadequate raw material (1%) was recorded the least factor limiting wood waste and forest residues utilization in the study area.

3.6. Environmental Challenges Associated with Forest Residues and Wood Waste in the Study Area

Nonindustrial application and general underutilization of forest residues and wood waste in the study area leads to some environmental challenges (Table 7).

Table 7: Environmental challenges associated with wood waste and forest residues in the study area

Categories	F (n=100)	Percentage (%)
Cause drainage problem	1	1.00
Causes Erosion	1	1.00
Fire Outbreak	8	8.00
Health Challenge (Respiratory)	11	11.00
Increase in Temperature	1	1.00
Loss of topsoil	22	22.00
No Idea	36	36.00
Pollution (Littering the environment)	20	20.00

Among the challenges reported are littering, loss of topsoil, respiratory health problems and fire outbreak. However, some of the timber operators in the area are not aware of any environmental challenges associated with wood waste and forest residues. Converting wood waste and forest residues to industrial products will ameliorate the environmental challenges posed by these waste and residues.

4. Discussion

Wood industries in the study area 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 agree with Rongo and Leon (2005) and Sambe et al.,(2021) 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 26-35 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 (Aiyeloja et al., 2013).

Wood wastes found across wood industries include, sawdust, plain shavings, wood offcut, wood backs, wood branches, wood chips and edgings, which are generated during wood processing in sawmills, furniture industries, timber shade, chain sawmill and during wood felling and delimbing. 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 use as local energy source for cooking, animal bedding and mulching stems from the fact that wood wastes are underutilized and rarely utilized for biofuel production, briquettes, particle boards, and other 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.

The level of wood waste utilization in the study area is very low, the reason is that most of the waste goes to animal bedding, mulching and for firewood which accounts for just a little percentage of the total wastes generated. Ogunwusi (2014) and Akhator et al.,(2017) 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 the study area is lack of awareness and information, as many timber operators in the study area are not aware that wood waste and forest residues can be used for other things other than what it is being currently used for in the study area. Majority of timber operators in the area lack awareness of industrial application of wood waste and forest

residues. Others though are aware of other applications of wood waste and forest residues, lack the knowledge and technical-know-how of converting these waste and residues to other useful products. The very few that has both awareness and technical-know-how lacks the capital to establish wood waste processing industries which will enable them to translate their knowledge to tangible products. This leaves a huge quantity of wood waste unutilized. Wood waste and forest residues handling and processing requires higher capital outlay, considerable development in technology and plant design. The findings by Ogunwusi (2014)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.

5. Conclusion

Although, the level of wood waste generation is very high in the study area, the level of utilization is very low, because of low presence of wood waste based manufacturing industries, leading to environmental nuisance. Thus, conversion of wood waste and forest residues to other useful products in the study area will result to industrial development, job creation, more economic development and healthier environment. It was found in this study that the major problems of industrial application of wood waste in the study area is lack of awareness of reuse values of wood wastes, lack of technical-know-how and lack of capital for those with technical-know-how. It is therefore recommended that awareness should be created on reuse value of wood waste in the study area. Timber operators and others should be trained and equipped with necessary skills to establish wood waste-based manufacturing industries through the intervention of Government and non-governmental organizations. Capital should also be provided to those with technical-know-how to enable them establish wood waste processing industries.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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