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UTILISATION OF WOOD RESIDUES FROM A CLUSTER OF SAWMILLS AT ILLABUCHI BY INHABITANTS OF SOME ADJOINING COMMUNITIES IN PORT HARCOURT, NIGERIA

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ABSTRACT

A large fraction of the total volume of wood meant for the Nigerian wood–based industry is primarily converted in sawmills. This, coupled with some other factors, explain why most of the wood residues, generated during log conversion, are in these sawmills. This scenario is also the case in a cluster of sawmills in Illabuchi, located in Port Harcourt Local Government Area (LGA), Rivers State, Nigeria. It was therefore considered necessary to carry out a study where questionnaire, face–to–face interviews and personal observations were used to elicit information concerning socio–economic characteristics, types of wood residues generated by these sawmills, pattern and purpose for which they were utilised including other associated necessary information. The respondents were randomly selected through the snowball technique from two purposively selected adjoining communities to this cluster of sawmills. Outcome of the survey, after descriptive statistical analyses of the data obtained, revealed that more than 50% of the respondents in the two communities were married, mostly having a family size consisting of between 4 to 6 people as members. The respondents' monthly income ranged from about ₦10,000 to slightly above ₦50,000, although, between 30 to 38% of the respondents declined to state what they earned monthly. Additionally, results showed that 45 to 58% of the respondents obtained the different types of wood residues from these sawmills for free with 6 to 32% of the respondents claiming to spend between ₦400 and ₦800 monthly for the same purpose. It was also shown by results that 44% of the respondents in the two communities agreed that the wood residues collected from sawmills were used for heating and cooking. Other applications are as bedding for poultry/other animals, flooring and planting of ornamental plants. The implication of the results obtained from this study is that additional applications effective in putting more of these sawmill wood residues into use should be encouraged. This is suggested and expected to be done in ways that will contribute more to local economy.

Key words: Sawmilling, log conversion, wood processing machines, wood residues

INTRODUCTION

Sawmilling was and is still known to be the largest of all the sectors of wood–based industry in Nigeria. Sawmills, collectively, is estimated to convert about 80%, or more, of the total volume of wood converted and processed in the country's wood–based industry. Therefore, the bulk of wood residues, such as slabs, off–cuts, barks, saw dust, shavings, peelings and other rejects, including those considered as waste, generated within this industry, are from the sawmills. These wood residues are observed to have increased in volume over the years owing to the decline in tree harvesting age, size and quality of log, among other reasons. Continuous increase in the volume of wood residues is also contributed to by converting logs with old and out–dated equipment (Akande *et al*., 2006; Erakhrumen and Idele, 2016). Consequently, studies showed that cubic lumber recovery (CLR) in Nigerian sawmills ranged from 40 to 50% or slightly above (Alviar, 1983, Fuwape, 1989; Akinbode and Olujimi, 2014; Erakhrumen

and Idele, 2016). These CLR values imply that up to, or more than, 50% of the total volume of logs converted in these sawmills end up as wood residues.

Some other factors contributing to this proportion of logs ending up as wood residues are type and age of machine, kerf characteristics of sawing blade, log form, type of wood (hardwood or softwood), experience of the operator and cutting dimension. The contributory factors are not limited to those earlier stated, among others is that additional wood loss is generated at the re–saw bench attached to the mill (Badejo and Giwa, 1983). In a study documented by Aina and Adekunle, (2004), it was noted that mean volume of wood residues generated per day in each of ten sampled sawmills in Abeokuta, Nigeria was 52.0m^3. With an estimated total of 44 sawmills in the study area, this totalled 2,288m^3 per day and 54,912m^3 per month, if the mills were to work for six days in a week. Similarly, in another study by Ogunbode *et al*., (2012), it was recorded, while examining some sawmills in Minna, Nigeria, that after a whole day's job, each sampled sawmill produced an average of 44 bags (approx. 50kg) of sawdust which is equivalent to 264 bags weekly.

Sawmill wood residues has collectively become a phenomenon worried about by stakeholders particularly as they–most times–impact negatively on sustainability of the environment and renewable natural resource base. This should be of concern because almost all sawmills in Nigeria have low CLR and mainly get rid of wood residues by burning (incinerating) them in open air (see plate 1). This is a challenge requiring solutions, considering for instance, that disposal of sawmill residues by burning became a serious source of air pollutant in Lagos, Nigeria (Dosunmu and Ajayi, 2002). Earlier, FAO, (1991) noted that wood waste dumped into or near water course can alter, disrupt or destroy fish habitat and also smother spawning ground areas, decreasing fish variety and abundance. Thus, use must be found for the different types of wood residues in ways that offer solution to challenges caused by them. For example, Badejo *et al*., (2000) stated that cement–bonded particleboards offer an option for overcoming the huge volume of sawdust generated in Nigeria's sawmills. This was deemed so because of the possibility of producing particleboards/other composite boards from wood residues generated from log conversion and re–sawing.

In addition, studies on appropriate technology for converting wood residues to energy in integrated wood industries showed that wood residues, through different combustion routes, can provide 21.1 to 33.3% of the total energy requirements in some of the country's paper mill outfits, such as Nigerian Paper Mill, Jebba, Nigerian National Paper Manufacturing Company Limited, Iwopin and Nigerian Newsprint Manufacturing Company Limited, Oku–Iboku, although, most of these paper mills are known to be currently under–performing. Another of such ways is their use as fuel in domestic and other industrial sectors. This is essentially because they are cheaper in fuel–importing countries, making the use of local biomass a means of saving substantial foreign exchange. FAO, (1990) observed that a large number of unskilled labour is engaged in growing, harvesting, processing, transporting and trading wood fuels. These activities are carried out regularly or in off–season. Additionally, it was reported that when crop harvests are inadequate for subsistence, wood fuel business provides a safety net for the affected people to generate income.

The use of wood and some other forms of biomass energy generates at least twenty times more local employment within the national economy than any other form of energy per unit (FAO, 1990). Most of the past studies on biomass energy as well as sawmill wood residues as energy source were focused on determining the quantities and types of fuel consumption whereas very few studies considered factors affecting household utilisation pattern of sawmill wood residues, for example, as energy source. Therefore, this study is aimed at examining the link between some socio–economic factors and utilisation patterns of sawmills wood residues within adjoining communities to a cluster of sawmills in Illabuchi, Port Harcourt, Rivers State, Nigeria. This is expected to provide background information on the types, pattern and quantities of sawmill wood residues obtained and utilised and how these may change in line with certain factors. It is envisaged that the outcomes of the study will assist in formulating appropriate strategies for managing wood residues in sawmills.

MATERIALS AND METHODS

Study area

This study was carried out in two peri–urban communities, inhabited by people, close to the cluster of sawmills at Illabuchi, i.e. Rumukalagbor

and Oroworukwo in Port Harcourt LGA. The study area is located between Latitude 04°47'20" – 04°48'40" N and Longitude 06°58'40" – 07°01'20" E (Fig. 1). Port Harcourt city is the capital of Rivers State, Nigeria. It has a total area of about 109km^2 with an elevation of 468m. Port Harcourt city is located in the Niger Delta region lying along the Bonny River, 66km upstream from the Gulf of Guinea. Port Harcourt is divided into the urban and greater/rural areas. It is recorded that as at 2016, the Port Harcourt urban area had an estimated population of 1,865,000 inhabitants, up from 1,382,592 as at 2006. The climate is tropical with daily temperatures averaging between 25°C and 28°C and rainfall measuring an average of over 210mm up to 367mm, heaviest between June and September. December, on average, is the driest month of the year, with an average rainfall of 20mm (Demographia, 2016; Wikipedia, Undated).

Data collection and analyses

Rumukalagbor and Oroworukwo communities were purposively selected as the study area for the questionnaire and other surveys because they were purely residential with inhabitants and are also in close proximity to the cluster of sawmills at Illabuchi (Fig. 1). The other identified areas shown on the map in Fig. 1 were mainly for commercial purposes and are mostly non–residential. Data collection was done through the use of questionnaire, face–to–face interviews and personal observations. The factors that were examined included marital status, household size, monthly income, amount spent in obtaining sawmill wood residues, types of sawmill wood residues and purpose for which they are used by the respondents in the two communities.

A total of one hundred and fifty (150) copies of same questionnaire were administered to the inhabitants of both communities using the snowball technique (50 copies of questionnaire in Rumukalagbor and 100 copies of questionnaire in Oroworukwo, based on proximity to the cluster of sawmills), on the spot interview relating to content of the questionnaire were also conducted for vital, relevant and necessary information. Secondary data such as those obtained from journals, technical publications and textbooks including other relevant information and materials needed for the study were also obtained from relevant literature, interviews and documents. The data obtained were statistically analysed using simple descriptive statistics such as mean, percentages and frequency counts.

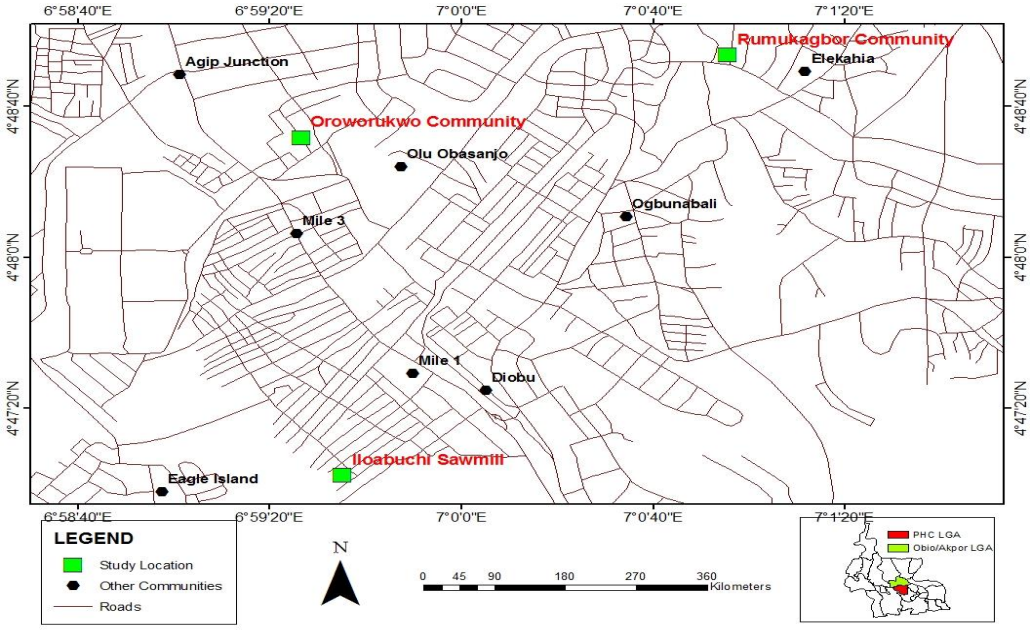

Figure 1: Map showing the peri–urban communities that served as the study area including the cluster of twenty–eight (28) sawmills at Illabuchi within Port Harcourt city

Plate 1: Heaps of wood residues, mainly comprising of wood slabs, barks and sawdust, at Dagogo sawmill, located among the Illabuchi cluster of sawmills

At the background, in Plate 1, are some debarked logs awaiting conversion in the sawmill

RESULTS

Results obtained in the two communities showed that between 53 to 56% of the respondents were married while slightly less than 30% of them were single with others being divorced (2–4%) or widowed (16–22%). It was also observed that 72% and 53% of the respondents belong to the group with family size of between 4 and 6 people in Rumukalagbor and Oroworukwo communities respectively while the number of respondents belonging to the group with family size >12 people was the least in the two communities. Furthermore, it was observed that more than 30% of the respondents (i.e. 36% in Rumukalagbor and 44% in Oroworukwo) had monthly income that was above ₦50,000. However, 38% and 30% of the respondents in Rumukalagbor and Oroworukwo respectively, declined to give any response regarding their monthly income (Table 1).

Table 1: Socio–economic characteristics of the sampled respondents in the study area

Variable	***Rumukalagbor Community***		***Oroworukwo Community***	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Marital status				
Married	28	56.0	53	53.0
Single	13	26.0	21	21.0
Divorced	1	2.0	4	4.0
Widowed	8	16.0	22	22.0
Total	**50**	**100.0**	**100**	**100.0**
Family size				
1–3	4	8.0	21	21.0
4–6	36	72.0	53	53.0
7–9	3	6.0	19	19.0
10–12	6	12.0	6	6.0
>12	1	2.0	1	1.0
Total	**50**	**100.0**	**100**	**100.0**
Monthly Income				
Up to ₦10,000	–	–	1	1.0
₦10,100 – ₦20,000	–	–	5	5.0
₦20,100 – ₦30,000	4	8.0	11	11.0
₦30,100 – ₦40,000	7	14.0	7	7.0
₦40,100 – ₦50,000	2	4.0	2	2.0
Above ₦50,000	18	36.0	44	44.0
No response	19	38.0	30	30.0
Total	**50**	**100.0**	**100**	**100.0**

It was observed that between 45% and 58% of the respondents in the two communities obtained wood residues from sawmills for free while between 6% and 32% of the respondents in the two communities said they spent between ₦400 and ₦600 weekly on obtaining wood residues from sawmills. Only 3% of the respondents in Oroworukwo community agreed that they spent between ₦600 and ₦800 weekly with 1% of the respondents, also in Oroworukwo community, agreeing to have spent >₦800 weekly for the purpose of obtaining wood residues from sawmills. There were also those who did not give response (i.e. 36% in Rumukalagbor and 19% in Oroworukwo) regarding their weekly expenditure on acquiring wood residues from these sawmills (Table 2).

Table 2: Respondents' weekly expenditure on acquiring sawmill wood residues in the study area

Weekly expenditure	***Rumukalagbor Community***		***Oroworukwo Community***	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Obtained free	29	58.0	45	45.0
₦400–₦600	3	6.0	32	32.0
₦600–₦800	0	0	3	3.0
>₦800	0	0	1	1.0
No response	18	36.0	19	19.0
Total	**50**	**100.0**	**100**	**100.0**

In addition, 44% of the respondents in the two communities stated that sawmill wood residues were sourced for the purpose of being utilised in heating/cooking. It was observed that up to 34% of the respondents in the study area stated that the wood residues were used as bedding for poultry and other animals with up to 18% of the respondents deciding not to give any response (Table 3).

Table 3: Purpose for which sawmill wood residues are utilised by respondents in the study area

Purpose for usage	***Rumukalagbor Community***		***Oroworukwo Community***	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Heating and cooking	22	44.0	44	44.0
Poultry/Poultry/another animals' bedding	17	34.0	1.0	1.0
Mulching	1	2	1.0	1.0
Heating/cooking, poultry/poultry/another animals' bedding	9	18.0	14	14.0
Heating/cooking and flooring	1	2.0	16	16.0
Heating/cooking, Poultry/other animals' bedding and flooring	–	–	6.0	6.0
No response	–	–	18	18.0
Total	**50**	**100.0**	**100**	**100.0**

In Table 4, cumulative results pertaining to the types and uses of sawmill wood residues showed that 60% of the respondents stated that sawdust was used for heating/cooking, flooring, poultry bedding and planting of ornamental plants while 24.9% of the respondents said that off–cuts from wood were mainly used for heating/cooking with 15.1% of the respondents stating that wood slabs were mainly used as floor covering in the two communities that served as the study area.

Table 4: Types of sawmill wood residues and their utilisation by respondents in the study area

Types of Wood Residues	*Purpose for Usage*	*Percentage*
Saw dust	Heating/cooking, Flooring, Poultry/other animals' bedding, Planting of ornamental plants	60.0
Bark of wood	Heating/cooking	–
Off–cuts from wood	Heating/cooking	24.9
Wood slabs	Flooring	15.1
Total		**100.0**

DISCUSSION

A careful analysis of the respondents' income in Table 1 appeared to indicate that significant number of them earned between ₦30,000 to over ₦50,000 monthly, giving the impression that this group of respondents tends to be more interested in the collection and use of sawmill wood residues, when compared with those that earned between less than ₦10,000 and ₦10,000–₦20,000 monthly. It is important to restate that the use to which the different types of sawmill wood residues are put are diverse as indicated in Tables 3 and 4. Resulting from the foregoing comparison, it may be safe to assume that almost all the respondents, by all standards, collectively belong to the category of low–income earners based on their socio–economic characteristic depicted in Table 1.

It also appeared that the respondents' western educational level influenced their responses relating to the usage of sawmill wood residues in the study area. This observation is in tandem with some past studies that showed that the higher this kind of educational level the much likely lower the utilisation of sawmill wood residues will be for some types of applications. For instance, families constituted of members having high level of western education tend to prefer energy–efficient technology and modern heating/cooking methods such as liquefied petroleum gas, electric and kerosene stove. Similar view indicating that this kind of educational level is a factor influencing wood fuel use in households in Nigeria was also documented by Nnaji *et al*., (2012). Moreover, households having their kitchen enclosed within their apartments are likely not to be interested in using woodfuel. It should also be borne in mind that for those who use wood as fuel there is likelihood that the larger the size of the family the larger the quantity used for this purpose will be.

The weekly expenditure on the procurement of wood residues, according to the respondents, is mostly incurred through expenses on transportation to and from the clusters of sawmills. The implication of this is that since between 45% and 56% of the respondents in the two communities claimed to obtain the various sawmill wood residues for free, they are mostly likely to have used cheap means of transportation or they may have trekked to the sawmills since the distance from their location/residence to the cluster of sawmills was within an average distance of 2.5km as indicated in the questionnaire by the respondents. On the other hand, some of the respondents in the two communities, i.e. 6% and 32% in Rumukalagbor and Oroworukwo respectively claimed to spend between ₦400 and ₦600 weekly, mainly on transportation to and from the sawmills. Largely, it could be seen from the results that the cost associated with the procurement of these wood residues from sawmills appeared to be low and the reasons are not far from the fact that these wood residues mostly appeared not to be useful in sawmills as sustainable value–added usage has not yet been found for them (Erakhrumen and Idele, 2016).

Aside from their use for heating/cooking, the sawmill wood residues were also useful for other applications such as bedding or litter for poultry/other animals, composted wood particles for the growing of plants and mushrooms by nurserymen and gardeners including usage for other types of flooring (Tables 3 and 4). The use of these wood residues for these types of applications had been earlier recorded in other published studies (Harkin, 1967; Alderman, 1998; Erakhrumen, 2006). It is noteworthy that these sawmill wood residues have been limited to the kinds of applications recorded in this study owing to the socio–economic characteristics of the interviewed respondents and Nigeria's current low level of technological development. Nevertheless, using these wood residues in the earlier stated applications is considered better instead of openly incinerating them. Although, the applications of

these sawmill wood residues in this study area still appear limiting in terms of economic advantages and environmental considerations.

Consequently, there are documented studies that have recommended these wood residues for different types of high value-added products (Ajayi, 2002; Olorunnisola, 2006; Erakhrumen *et al*., 2008). In line with these recommendations there is the need for the provision of sustainable enabling conditions for advanced technical capacities and investment interests in the utilisation of these wood residues for higher value-added products such as reconstituted wood composites. Wood composite manufacturing has the potential of becoming a large industry in developing countries like Nigeria since their products will assist in the efforts at achieving, for example, low–cost housing projects (Erakhrumen *et al*., 2008). Worldwide demand was reported for glued–wood composite products such as particleboard, medium–density fibreboard and plywood to increase in recent past.

There are expectations that future demand of these wood composites will continue to increase, especially for housing construction and furniture manufacturing (Youngquist, 1999; Sellers, 2000). This development, if well exploited, is expected to be of immense benefit to people having the socio–economic characteristics as those described for the respondents in this study. There is no doubt that the levels of contributions of these sawmill wood residues to local economy is beyond the scope of this study being reported, nonetheless, studies have shown that they are presently trivialised owing to lack of reliable up–to–date data coupled with inadequate or lack of modern methods of adding value to them for increased acceptance and usage, however, as stated earlier, they have been shown to possess the potentials of serving as a veritable means of income generation (Angelsen *et al*., 2014).

CONCLUSION AND RECOMMENDATIONS

The outcomes of this study showed that wood residues are still being generated in the cluster of sawmills in Illabuchi, Port Harcourt, Nigeria. The results also revealed that some parts of the wood residues were obtained by respondents, either freely or were paid for, and utilised in some applications. Nevertheless, it is believed that these residues are limited to the applications reported here owing to the prevalent socio–economic characteristics of the sampled respondents in the study area. It is therefore recommended that increased usage of these wood residues should be encouraged for those identified and other high value applications in order to further reduce the quantity of these wood residues that are not utilised.

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