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Research Article

Effect of Seasoning on Sawn Timber and Its Implications on Marketing in Bo and Kenema Cities (South and Eastern Sierra Leone)

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Abstract: Wood seasoning is the process of inducing reduction of the moisture contained in wood; a type of hydrothermic treatment of wood. This process of removing moisture from the wood minimizes structural problems such as dimensional stability, deterioration etc when the wood is used in construction, furniture production or to reduce smoke and ensure more uniform combustion when wood is used as fire wood. This research investigated the effect of seasoning on sawn timber and its implications on their marketing in Bo and Kenema cities. The following seasoning parameters were investigated: current wood seasoning methods, prevailing wood storage and seasoning conditions, potential loss in income, seasoning defects and impact on wood quality. The methodology entailed administration of questionnaires to 41 respondents (20 timber sales agent in Bo and 21 in Kenema). In Bo and Kenema cities 45% and 19% had knowledge of wood seasoning while 55% and 81% had no idea of wood seasoning respectively. Also 75% of respondents in Bo city and 42% in Kenema owned timber stores. Wood seasoning is more prevalent in Bo city than in Kenema city. More timber sellers in Bo had their own stores than in Kenema. Majority of merchants stack timber by dimension. Ministry of Agriculture Forestry and Food Security to provide resource person for training timber sales agents.

Keywords: Moisture content, Wood defects, seasoning, Storage.

Introduction

Defects in sawn timber are any irregularities appearing in or on the timber surface that may reduce its strength in construction work, durability, quality, and attractiveness if used for furniture, joinery etc. It may occur in the timber during growth, during felling process or during seasoning depending on the place and method of seasoning (Maree and Malan, 2000). Poor or non-seasoning generally affects timber marketing and utilization for a variety of end uses, due to the associated defects.

One of the key factors limiting the use of young and immature plantation grown timber as saw logs in timber production, is the high percentage of moisture content within the timber (Waugh 1998, 2000; Garcia, 1999). The immature trees have a high component of juvenile wood which is easily destroyed by insects and fungi which take advantage of its relative softness and high sugar content, which provides food for them.

Wood seasoning is the process of inducing reduction of the moisture contained in wood; a type of hydrothermic treatment of wood. This process of removing moisture from the wood minimizes structural problems such as dimensional stability, deterioration etc when the wood is used in construction, furniture production or to reduce smoke and ensure more uniform combustion when

wood is used as fire wood. Dry wood, although lighter than green wood, which still contains moisture, is stronger, less likely to warp or mold and is easier to finish with paint or varnish. The length of the seasoning process depends on the type of wood used influenced by temperature, relative humidity etc in the area where the wood is seasoned **(**Desch *et al.*, 1996).

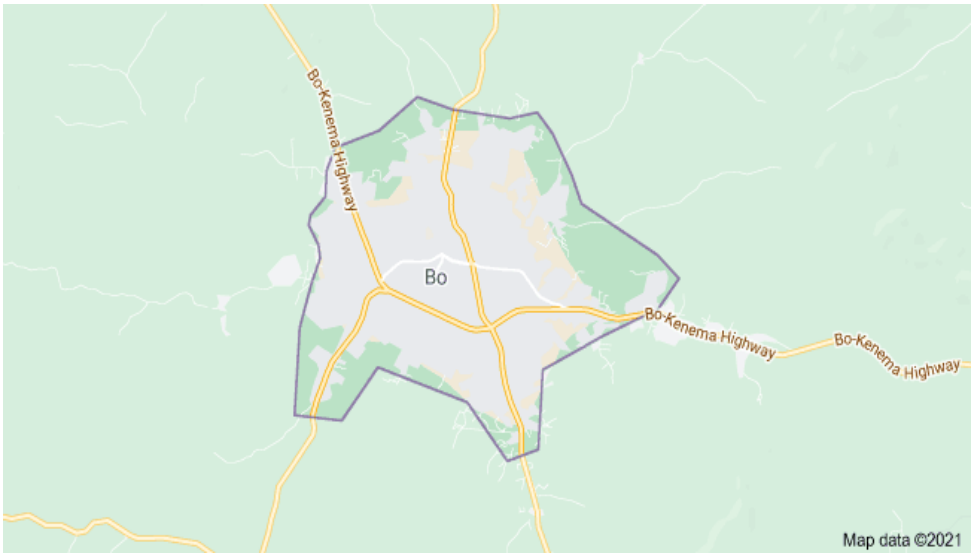
There is generally limited knowledge on the importance of seasoning, methods of seasoning, the principles involved in the seasoning of lumber, wood disks and other small pieces of wood in Sierra Leone were wood producers and users are not conversant with seasoning knowledge, process and the conditions necessary for successful seasoning. Good seasoning determines the overall quality of wood and subsequently commands its price, durability and enduses. Therefore, it is imperative that research is conducted to introduce wood producers and users to appropriate seasoning and storage methods that can enhance wood quality and usage and even avoid wood waste due to wood deterioration. The current research is intended to assess the moisture content of wood species in Bo and Kenema.

Limitation(s) and constraints of this research

The timber sales agents and carpenters in Bo and Kenema cities were very reluctant to provide information on their profits, knowledge and experiences, due to fear of taxation by government as a hidden rational of my research. Timber sales agents were in different locations within Bo and Kenema Cities, in terms of locating them was very tough.

Materials and Method

Description of study areas

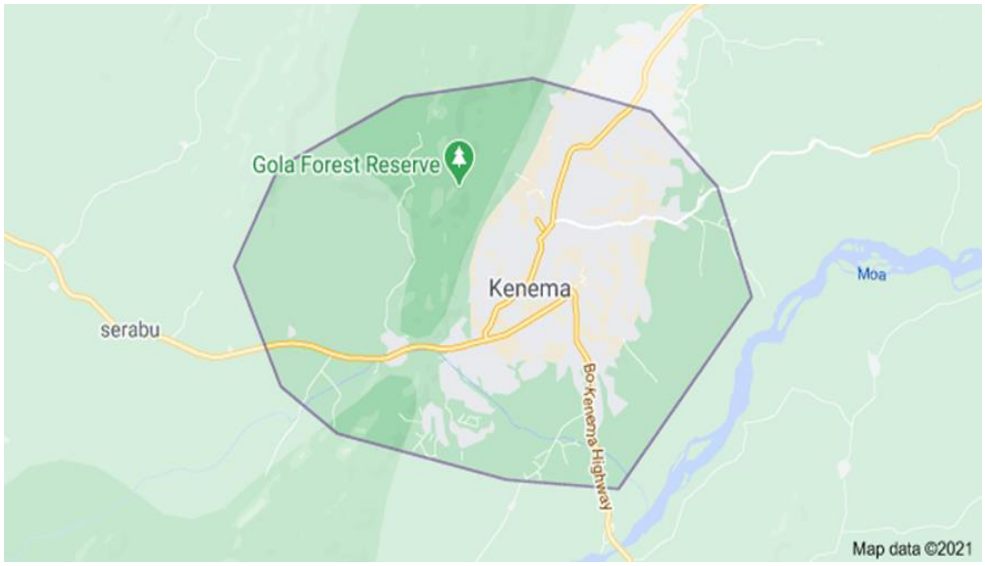


Bo district is located in Southern Sierra Leone, being the second most populous district in the country after the Western Area Urban, with a population estimate of 574,201 (2015 census). It borders Kenema district to the east, Tonkolili district to the north, Moyamba district to the west, Bonthe district to the southeast and Pujehun district to the south, occupying a total area of 5,473,6 km^2 and comprises fifteen (15) chiefdoms including; Badjia, Bagbe, Baoma, Bumpe Ngao, Jaiama, Kakua, Komboya, Lugbu, Niawa, Lenga, Tikonko, Valunia, Wonde and Gbo. During May to October (rainy seasoning), the district receives an average of 292cm rainfall annually.

The population of Bo district is ethnically, culturally and religiously diverse with the Mende people forming the largest group of about 60% of the population, while the remaining 40% are from other ethnic groups. Economically, the district is known for agricultural productivity as well as mining of particularly gold and diamonds. The district is relatively forested with cocoa and coffee plantations established. Also under the canopy of these secondary forest trees, timber, poles and non-timber

forest products such as, honey, rope, mushroom etc. are extracted for building construction, medicines, food etc.

Bo city is the provincial headquater of the district, located in the Kakua Chiefdom. It is mostly a trading city with vegetable gardening activities taking place as well. Such trading activities include, the sale of food stuffs, clothing, sawn timbers especially; *Gmelina arborea*, *Terminalia ivorensis*, *Mitragyna stipulosa* etc. The City also benefited from the now-closed railway line. The mayor is responsible for the general management of the city.



Kenema, the provincial and district headquater is the third largest city in Sierra Leone (after Freetown and Bo) and the largest city in the Eastern Province. It has a population of 609,873 (2015 census). The rainfall intensity in the district ranges from 2001 mm to 3000 mm per year. It is an important agricultural marketing centre for timber, cocoa, coffee, palm oil, palm kernels (like Bo city), furniture, and wood carvings are also produced and transported mainly by road to Freetown for sale and export to other countries.

Kenema lies approximately 300 kilometres (185 mi) south-east of Freetown and about 60 kilometres (40 mi) south of Bo.

Kenema is one of the most ethnically diversed cities in Sierra Leone and is home to a significant numbers of many ethnic groups. The Mende language seems to be the most widely spoken language in the city.

The city of Kenema is one of Sierra Leone's six municipalities, governed by a directly elected city council form of government, headed by a mayor, in whom executive authority is vested.

Sample size and selection of respondents

A preliminary survey was done in Bo and Kenema cities (22nd and 24th February 2016) from which respondents were selected. There were 20 registered timber sales agents in Bo city, and 21 timber sales agents in Kenema city, making a total of forty-one respondents were targeted for sampling. All the timber sales agents completed the questionnaires appropriately.

Data collection procedure

Data was collected through the administration of structured questionnaires, direct interviews and personal observations to complete this research work. The questionnaire covered the following issues: Prevailing wood storage and seasoning conditions, potential loss in income, seasoning defects etc.

Data analysis

SPSS is a widely used program for statistical analysis in scientific research. It is also used by market researchers, health researchers, survey companies, government, educational researchers, marketing organizations, data miners etc. The original SPSS manual (Wellman, 1998) has been described as one of "sociology's most influential books" for allowing ordinary researchers to do their own statistical analysis. The data collected in this study was analyzed using Statistical Package for Social Scientists (S.P.S.S., Version 20.0). This package was used to give results on the following parameters: age, sex, educational background and seasoning defects etc, which provided positive outcome of the study. One of the key advantages of SPSS is the ability to simply open an excel file in its own screen and edit information, without having to go through a complex import/export processes. It also has the inherent windows properties such as cut, copy, paste, find, replace, etc., which makes it easy for a non-SPSS user to gain familiarity with the system, particularly if one has experience using MS Office tools.

Presentation of results

The results obtained were presented in bar charts and tabular form based on the following respondents parameters; age, sex, educational background and the following technical information on seasoning defects.

Results

Table 1. Sex of respondents

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Male	19	95	17	81
Female	1	5	4	19
Total	**20**	**100**	**21**	**100**

Table 1 shows that 95% of the respondents are males and 5% are females in Bo city, whilst in Kenema city 81% of the respondents are males and 19% are females.

Marital status of respondents in both cities

Respondents were interviewed about their marital status in the timber market. The results obtained were analyzed in figure 1.

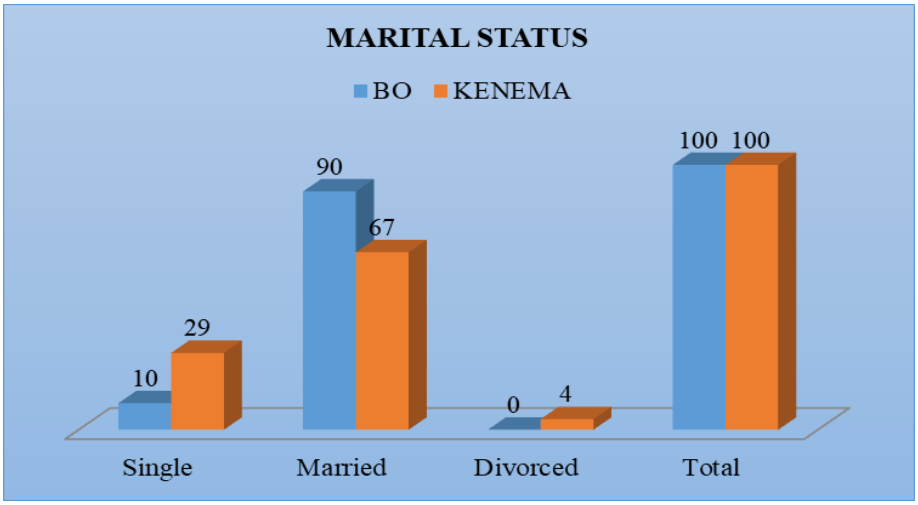


Figure 1. Marital status of respondents

From figure1, 90% of the respondents in Bo city are married whilst 10% are single. In Kenema city however, 67% of the respondents are married, 29% are single and 4% divorced.

Age of respondents in the timber markets in Bo and Kenema

The following table shows the age classes of respondents in Bo and Kenema.

Table 2. Age of respondents

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
18-30	4	20	5	24
31-40	4	20	8	39
41-50	6	30	6	29
51-60	3	15	1	4
Above 60	3	15	1	4
Total	**20**	**100**	**21**	**100.0**

Table 2 shows that in Bo city, the highest percentage (30%) of respondents were between the age classes of (41-50); followed by (20%) for age classes (18-30) and (31-40); while the age classes of (51-60) and (60 above) were least represented by (15%).

However the trend was different in Kenema; as the results show that the highest proportion (39%) of respondents were belonging to the age class (31-40). This is followed by (29%) of age classes (41-50); (24%) of age classes of (18-30) and (4%) of age classes (51-60) and (60 above).

Level of educational achievement by respondents

The following figure shows the educational level of respondents in Bo and Kenema.

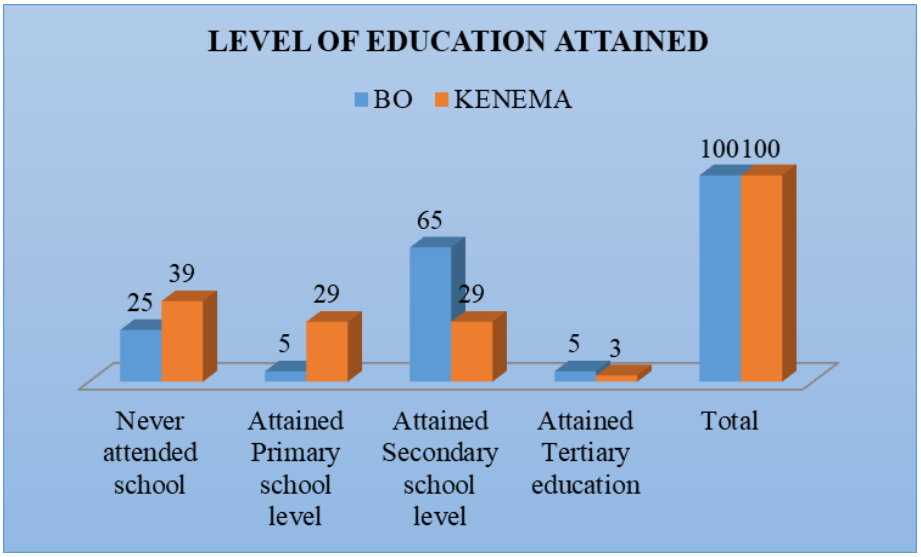


Figure 2. Educational level of respondents

From figure 2, 65% of respondents in Bo city attained secondary level education, 5% attained tertiary education, 5% attained primary level and 25% never attended school. For Kenema city 29% of the respondents attained secondary school level, 3% attained tertiary education, 29% attained primary school level and 39% never attended school.

Prevailing wood seasoning methods in the study area

Knowledge of wood seasoning

Respondents (who owned timber stores) were asked if they have any idea about wood seasoning. Some said yes whilst others said no and the results were analyzed in table 3.

Table 3. Knowledge of wood seasoning

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Yes	9	45	4	19
No	11	55	17	81
Total	20	100	21	100

Table 3 shows that, 45% of the respondents in Bo have idea on wood seasoning, whilst 55% of the respondents had no idea. In Kenema city 19% of the respondents had idea on wood seasoning whilst 81% had no idea.

Implementation of timber seasoning

Plank sellers were asked if they normally season their sawn planks. Some said yes and others said no. The results obtained from their responses were analyzed in figure 3.

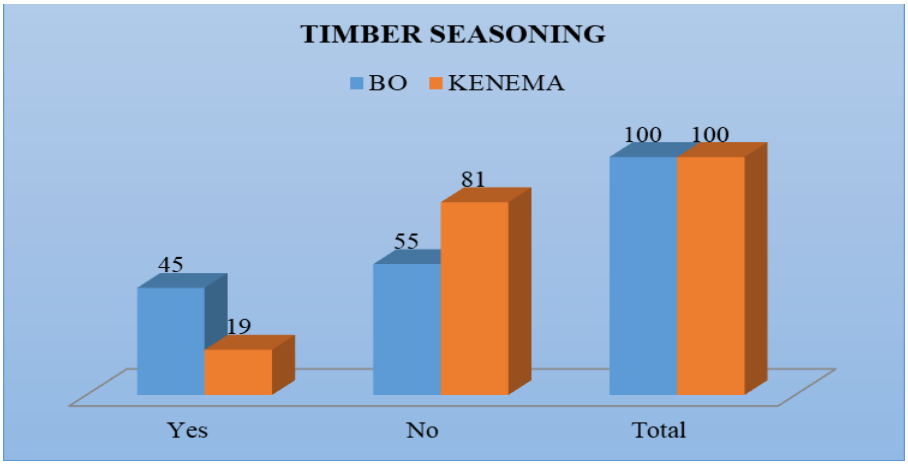


Figure 3. Those who season their wood planks

Figure 3 indicates that 45% of the respondents in Bo city are practicing air drying wood seasoning, whilst 55% were not practicing air drying wood seasoning. In Kenema city 19% of the respondents are practicing air drying wood seasoning, whilst 81% are not practicing air drying wood seasoning.

Methods used in timber seasoning

Responses obtained from timber sellers in Bo and Kenema indicated that only indoor and outdoor air drying seasoning methods were practiced. The results obtained from their responses are presented in figure 4.

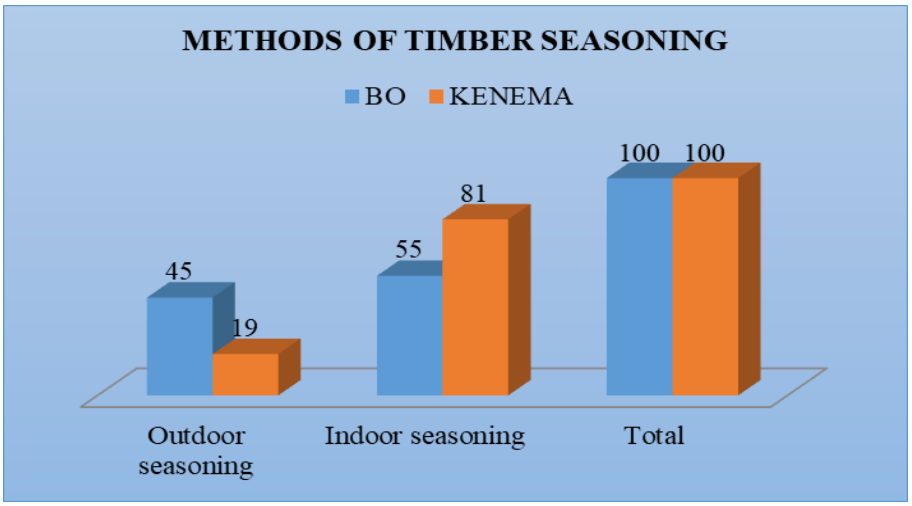


Figure 4. Types of seasoning methods

It is shown in the figure 4 that 55% of the respondents in Bo city are using the indoor method of seasoning their planks, whilst 45% are using outdoor seasoning method. With regards to Kenema city, 81% of the respondents are using indoor seasoning method whilst 19% are using the outdoor seasoning method.

Prevailing storage conditions and sawn wood defects at key Bo and Kenema timber stores
Ownership of timber stores in Bo and Kenema cities
Respondents in these two cities were asked if they have a timber store to keep their sawn planks. The results obtained from their responses were analyzed in table 4.

Table 4. Ownership of timber store

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Yes	15	75	9	42
No	5	25	12	58
Total	20	100	21	100

It is indicated in table 4 that 75% of the respondents in Bo city owned timber stores whilst 25% of the respondents do not owned timber stores. With respect to Kenema city 42% of the respondents owned timber stores whilst 58% do not owned timber stores.

Prevailing storage methods of sawn timber
Respondents were asked under what condition they store their sawn timber. Majority of them made mention of indoor storage whilst few made mention of outdoor storage. The results obtained were analyzed in figure 5.

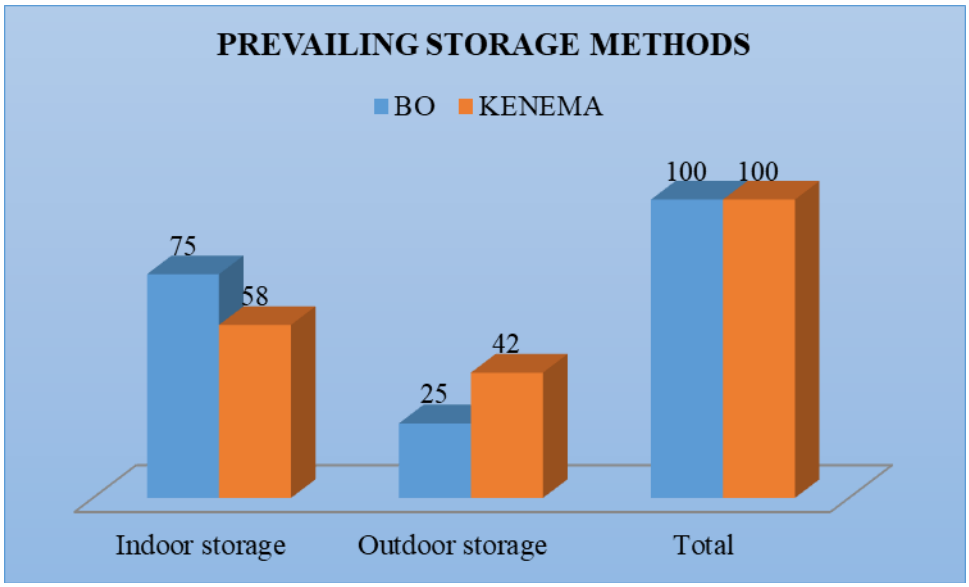


Figure 5. Prevailing storage condition of stored sawn timber

From figure 5, 75% of the respondents in Bo city used the indoor storage method, whilst 25% used outdoor storage. In Kenema city, 58% of the respondents used indoor storage condition, whilst 42% of the outdoor storage.

Stacking of sawn timber
Timber sellers were asked if they normally stack their planks. And the results obtained were analyzed in figure 6.

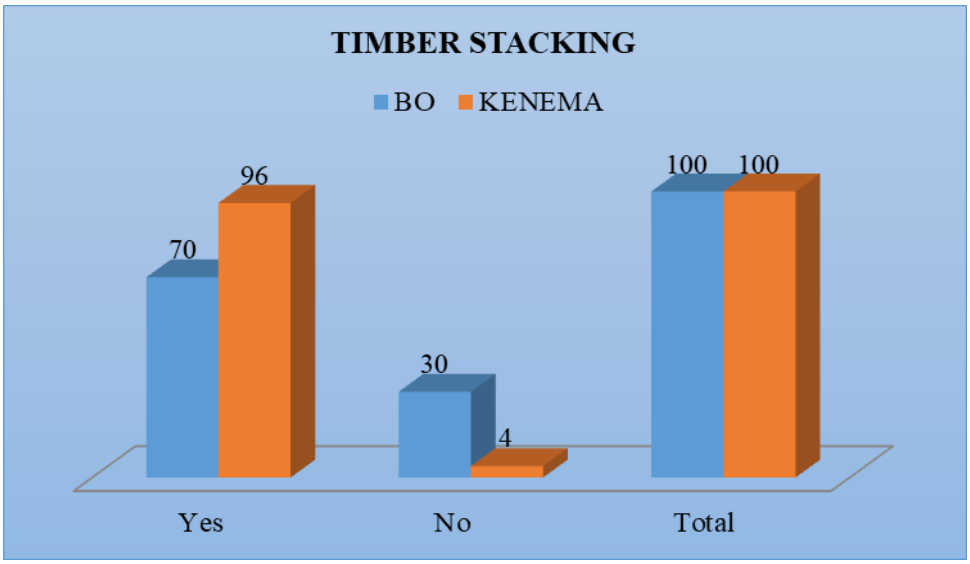


Figure 6. Number of respondents who stack planks

Figure 6 indicates that 70% of the respondents in Bo city practiced timber stacking whilst 30% do not practice timber stacking. In Kenema city 96% of the respondents practice timber stacking whilst 4% do not practice timber stacking.

Method of stacking timber in the timber market

Respondents were asked how they stacked their planks. Majority of the plank sellers stack timber by dimension whilst few stack their timber randomly. The results obtained were analyzed in table 5.

Table 5. Method of stacking timber

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Randomly	5	25	9	42
By dimension	15	75	12	58
Total	20	100	21	100.0

Table 5 indicates that 25% of the respondents in Bo city used the random stacking method whilst 75% do stacking by dimension. In Kenema city, 42% stacked timber randomly whilst 58% stacked timber by dimension.

Starting of timber defects

Timber sales agents were asked to indicate when timber defects begin on the planks. Out of 100% respondents majority (91%) are claiming that timber defects originated from the field whilst some mentioned during outdoor display. The results obtained were analyzed in table 6.

Table 6. Origin of timber defects

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
From the field	14	70	21	100
Outdoor display	6	30	0	0
Total	20	100	21	100

Table 6 indicates that 70% of the respondents in Bo city believe timber defects start from the field whilst 30% believe that it starts when timber is displayed outside. However 100% of the respondents in Kenema believe that defects start from the field and splitting is the most paramount defect.

Type of defects seen on the plank

Respondents were asked the type of defects they notice on the plank. Sawn plank sellers mentioned surface splits, molding, cupping, twisting and bowing as the various defects seen on the plank. Surface splits is in the majority followed by molding, twisting, cupping and bowing which is the least.

The results obtained from their responses were analyzed in figure 7.

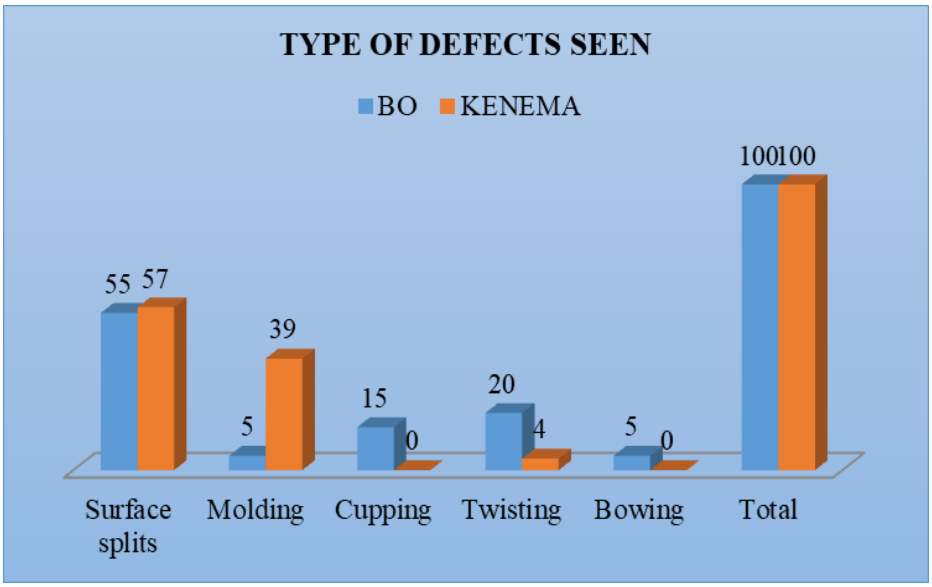


Figure 7. Types of defects seen on the plank

Figure 7 indicates that 55% of the respondents in Bo city identified surface splits as the common defects seen on planks, 5% identified molding, 15% identified cupping, 20% identified twisting and 5% identified bowing as common defects. However in Kenema city, 57% of the respondents indicated surface splits as common defect on planks, 39% indicated molding, 4% indicated twisting as common defects on planks.

Affected sawn timber dimensions

Sawn plank sellers were asked which of the different dimensions of sawn planks is/ are affected by these defects. The results obtained from their responses were analyzed in figure 8.

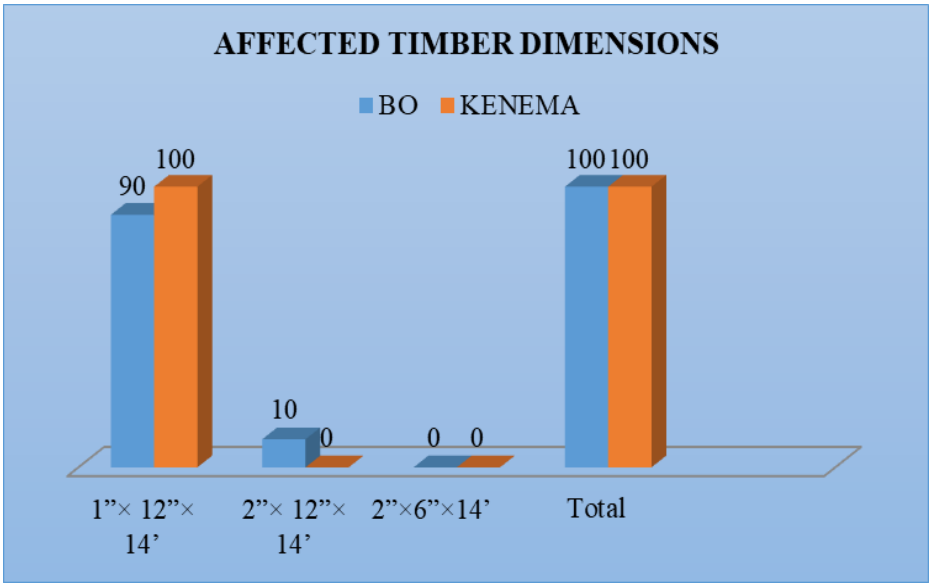


Figure 8. Dimensions of sawn planks that are severely affected by these defects

Figure 8 shows that 90% of respondents in Bo city identified (2.54cm × 30.48cm × 426.72cm) plank to be more prone to defects, whilst 10% identified (5.08cm × 30.48cm × 426.72cm) to be proned to defects. In Kenema city however 100% of the respondents identified (2.54cm × 30.48cm × 426.72cm) to be more defective than any other timber dimension in the timber market.

Species that are more susceptible to wood defects

Respondents were asked which of these species were more susceptible to defects. Majority of them named *Tectona grandis*, followed by *Gmelina arborea* and *Terminalia ivorensis*. The results obtained were analyzed in table 7.

Table 7. Identification of species that are more susceptible to wood defects

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Gmelina arborea	10	50.0	6	29
Terminalia ivorensis	4	20.0	1	5.0
Tectona grandis	6	30.0	14	67
Others	0	0	0	0
Total	20	100.0	21	100.0

Table 7 indicates that 50% of the respondents in Bo city considered *Gmelina arborea* to be more susceptible to these defects, 20% identified *Terminalia ivorensis* and 30% mentioned *Tectona grandis*. In Kenema city however, 67% identified *Tectona grandis* followed by 29% for *Gmelina arborea* and 5.0% indicated *Terminalia ivorensis.*

Effects of wood defects on timber quality and Income to sellers.

Quantity of sawn timber

Respondents were asked about the quantity of sawn timbers in their stores. The results obtained from their responses were analyzed in figure 9.

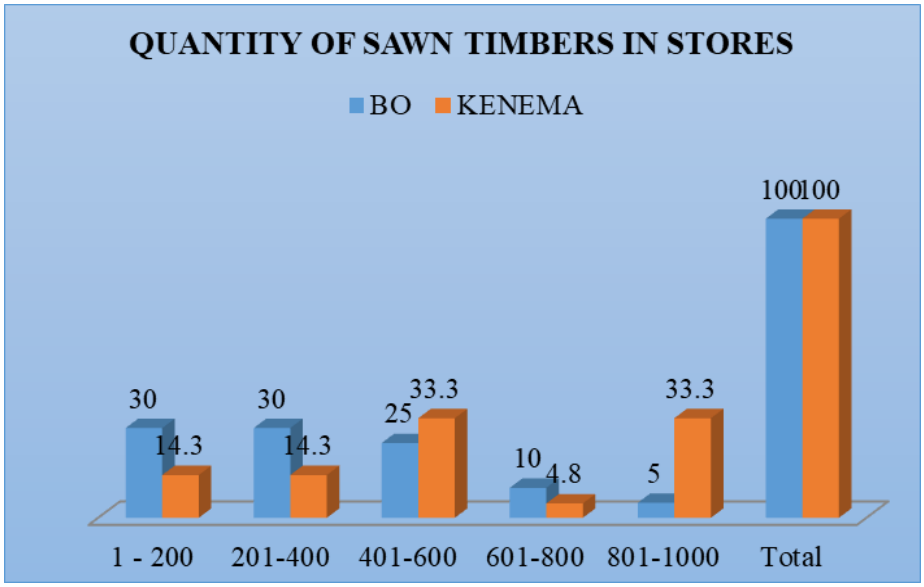


Figure 9. Quantity of sawn timber in stores

According to figure 9, 30% of respondents in Bo city fall about 1-200 planks, 30% fall about 201-400 planks, 25% fall about 401-600 planks, 10% fall about 601-800 planks and 5% fall about 801-1000 planks storage. In Kenema city 14.3% of the respondents fall about 1-200 planks, 14.3% fall about 201-400 planks, 33.3% fall about 401-600 planks, 4.8% fall about 601-800 planks and 33.3% fall about 801-1000 planks.

Total number of sawn timber affected in the timber market

Sawn plank sellers were asked about the total number of affected sawn timber in their stores and the results were analyzed in figure 10.

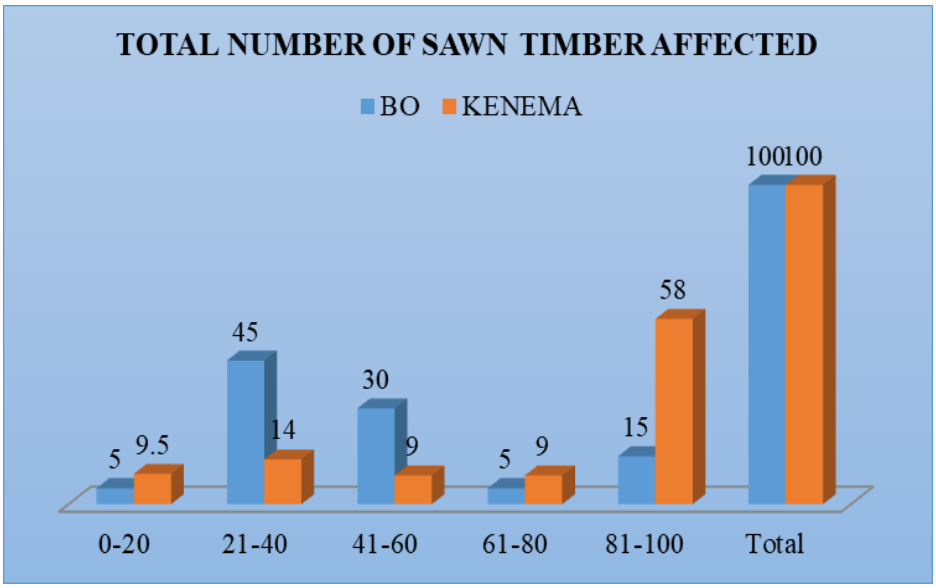


Figure 10. Number of planks affected by defects

Figure 10 indicates that 5% of respondents in Bo city indicated 0-20 affected planks, 45% indicated 21-40 affected planks, 30% indicated 41-60 affected planks, 5% indicated 61-80 affected planks and 15% indicated 81-100 affected planks. With respect to Kenema city 9.5% of the respondents indicated 0-20 affected planks, 14% indicated 21-40 affected planks, 9% indicated 41-60 affected planks, 9% indicated 61-80 affected planks and 58% indicated 81-100 affected planks. In Bo city, the quantity of defected planks were of 21-40, whilst in Kenema city number of defective planks was 81-100 planks.

Time of the year when planks are prone to sawn plank defects

Respondents were asked to indicate what time of the year sawn planks are more susceptible to defects, Majority mentioned the rainy season while a few mentioned the dry season. The results obtained were analyzed in table 8.

Table 8. Time of the year when planks are more prone to defects

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Rainy season	14	70	10	48
Dry season	4	20	3	14
All the time	2	10	8	38
Total	20	100	21	100

Table 8 shows that 70% of the respondents in Bo city indicated that planks are more susceptible to defects during the rains, while 20% mentioned the dry season and 10% mentioned both seasons. In Kenema city 48% plank defects occurred more during the rainy season, while 14% indicated the dry season and 38% identified both seasons for occurrence of defects.

Seasonal variation in plank selling price

Plank sellers were asked which time of the year is sawn plank more valuable. Majority of the respondents in both cities made mention of the dry season whilst few mentioned the raining season. The results were analyzed in table 9.

Table 9. Seasonal variation in plank price

	BO		KENEMA	
	Frequency	**Percentage (%)**	**Frequency**	**Percentage (%)**
Dry season	12	60.0	14	66.7
Rainy season	8	40.0	7	33.3
All the time	0	0	0	0
Total	20	100.0	21	100.0

Table 9 indicates that, 60% of the respondents in Bo city indicated that sawn planks are more expensive during the dry season than in the rainy season, whilst 40% indicated that sawn planks are more expensive during the rainy season. Also 66.7% of the respondents in Kenema city indicated that sawn planks are more expensive during the dry season and 33.3% said is expensive during the rainy seasoning.

Impact of timber seasoning on profitability

Respondents were asked about the impact of defects on profitability. The results obtained were analyzed in figure 11.

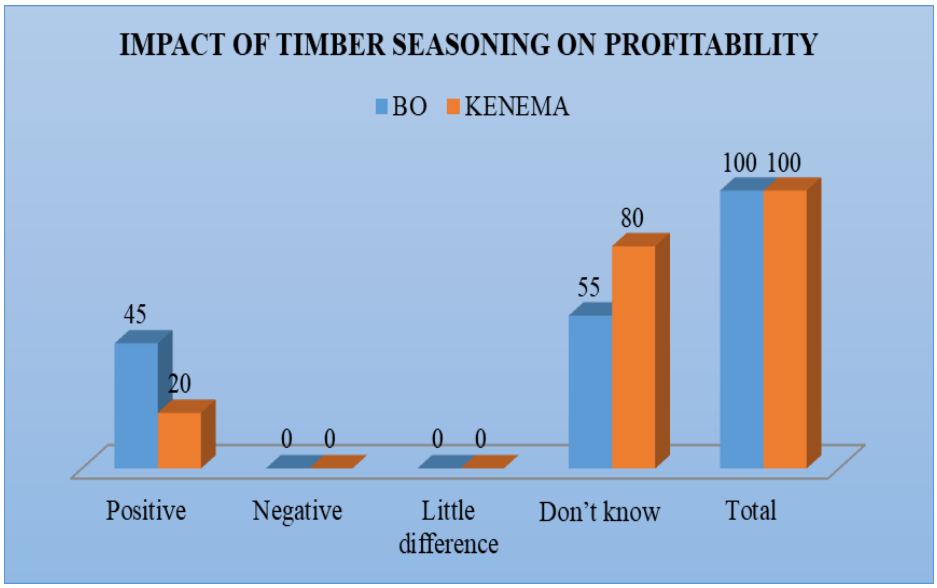


Figure 11. Impact of sawn timber defects on profitability

Figure 11 indicates that 45% of the respondents in Bo city indicated that defects reduce profitability, whilst 55% had no idea. Also in Kenema city 20% confirmed that defects reduce profitability, whilst 80% had no idea.

Discussion

The use of questionnaires was to gather basic information on the effect of seasoning on sawn timber and its implications on marketing in Bo and Kenema cities. 21 questionnaires were administered in Bo and 20 were administered in Kenema making a total of 41 completed questionnaires. The result in (Table 1). Indicates that there are fewer women than men that were involved in timber trade in both cities probably due to tedious nature of the job which discourages the womenfolk.

Figure 1 shows that married men are more likely to acquire loans from financiers probably using their families as sort of collaterals. The age class of 18-50 years are more involved in the timber business in Bo than other age categories. Age, experience and probably stable financial standing could be achieved in this age bracket. However the trend was different in Kenema; as the results show that the highest proportion (39%) of respondents were belonging to the age class (31-40) (Table 2).

Attainment of secondary school education is a prerequisite for profit and loss calculations, so Bo sellers are more at advantage than Kenema sellers (Figure 2). According to my findings there are more damaged timbers in Kenema than in Bo which severely affect profit maximization in the timber market (Table 3). Figure 3 implies that, wood seasoning is more prevalent in Bo city than in Kenema city. This result can be corroborated with that of Krechetov, I. V. Sushka drevesiny. Moscow. (1972). Figure 4 shows that, plank sellers in both cities are using the indoor seasoning method more than the outdoor seasoning method. Table 4 clearly shows that timber sales agents owned more stores in Bo than Kenema.

From the overall view respondents in both cities favoured the indoor storage to the outdoor storage method (Figure 5). Figure 6 indicates that, since majority of respondents practice timber stacking, the idea is hopefully expected to be inculcated by others over time.

Stacking by dimension makes sales easier than stacking randomly. It also ensures a relatively free flow of air over the lot especially if pegs are used (Table 5). Table 6 shows that felling method; falling position (rocky and flat floor) and strains imposed by twisting of trees during the process are possible causes of these defects from the field.

Figure 7 indicates defects that lead to drop in economic value of the planks resulting in reduced economic gains. For Bo and Kenema cities (2.54cm × 30.48cm × 426.72cm) was identified as more proned to defects. (5.08cm × 15.24cm × 426.72cm) respondents in both cities did not comment on it (Figure 8). 50% of the respondents in Bo city considered *Gmelina arborea* to be more susceptible to these defects, 20% identified *Terminalia ivorensis* and 30% mentioned *Tectona grandis*. In Kenema city however, 67% identified *Tectona grandis* followed by 29% for *Gmelina arborea* and 5.0% indicated *Terminalia ivorensis* (Table 7).

The result in (Figure 9). Clearly shows that there are more sawn timber sales agents, with high quantity of sawn planks in Kenema city than in Bo city. Kenema city had been exposed to large timber trade from the 1960s to late 90s mostly produced by the Forest Industries Corporation and the Panguma sawmill before the rebel war. This situation may still have influence on timber trade in the area. The result in (Figure 10). Implies that more planks are defective in Kenema than in Bo, because of the inefficient seasoning methods mostly used in Kenema. Poor seasoned planks will lead to wood rot which provides entrance to wood borers to enter and feed resulting in losses in the business.

It is clearly shown in table 8 that plank defects occurred more during the rainy season than in the dries.

Table 9 indicates the high cost of sawn planks during the dry season may be as a result of the rapid construction work taking place during the dry season. The heavy rains often disturb outdoor construction work. As the demand increases, the price is bound to increase according to the demand influence on price. High demand could result in scarcity further increasing price in response. The result in Figure 11 implies that a huge number of the respondents in both cities had no idea on the negative impact of defects on profitability. Seasoned timber lasts long and is more stable in use for little expansion and shrinkage. It is more attractive without algal and fungal dressing. Visibility on the negative impact on defects on profitability could benefit the innocent respondents and possibly turn around the situation.

Conclusion

- ✓ More males are involved in sawn plank selling and majority are married.
- ✓ 18-50 years old respondents are more involved in timber business. This maturity necessary in this business.
- ✓ Most of the respondents in Bo and Kenema attained secondary education.
- ✓ Bo city plank sellers have more knowledge of wood seasoning than Kenema city timber sellers.

- ✓ Wood seasoning is more prevalent in Bo city than in Kenema city, probably due to experience.
- ✓ Plank sellers in Bo and Kenema cities use more indoor seasoning method which protects planks from deterioration.
- ✓ Most timber sellers in Bo city owned timber stores unlike in Kenema city.
- ✓ Most respondents in Bo city use storage conditions (the indoor storage method) than in Kenema.
- ✓ Kenema city practice more timber stacking than in Bo. And this could be responsible for reduced deterioration.
- ✓ Majority of merchants do stack by dimension, whilst minority do random stacking which makes stacking very difficult.
- ✓ 70% - 100% of respondents in Bo and Kenema cities believed timber defects start from the field with splitting the most prominent.
- ✓ Most respondents in the two cities identified surface splits and molding as the two prominent defects seriously affecting planks in and out of the field, resulting in financial losses.
- ✓ It can be concluded that, (2.54cm × 30.48cm × 426.72cm) was more proned to defects. The 5.08 thick planks (being thicker) are less affected according to respondents in both cities.
- ✓ 50% of the respondents in Bo city considered *Gmelina arborea* to be more susceptible to these defects, 20% identified *Terminalia ivorensis* and 30% considered *Tectona grandis* to be more susceptible to defects. In Kenema city however 28.6% of the respondents identified *Gmelina arborea* as more susceptiple to these defects, 4.8% considered *Terminalia ivorensis* as susceptible, 66.7% identified *Tectona grandis* as more susceptible to defects.
- ✓ There are more sawn timber sales agents, with high amount of sawn planks in Kenema stores than in Bo timber stores.
- ✓ The highest quantity of defected planks in Bo city fall within the quantity brackets of 21-40, whilst in Kenema city the highest quantity of defected planks fall within the quantity brackets of 81-100. In both cities plank defects happened more in the rains.
- ✓ Sawn timber was more expensive in the dry season in both cities due to high demand, more building construction during the dries.
- ✓ Timber defects had negative impacts on profitability in both cities based on price depreciation in both cities.

Recommendations

- ✓ Ministry of Agriculture Forestry and Food Security should fully educate timber sales agents about the positive effects of wood seasoning in Bo and Kenema cities respectively.
- ✓ Training of local authorities on merchantability girth limit.
- ✓ Government and Non-governmental Organizations should support the training of powersaw operators, timber sellers and carpenters in timber seasoning and the advantages of seasoned timber.
- ✓ Foresters should be engaged on planting suitable wood species that have high density and less absorption of moisture content, which will enable the wood to be free from rot, decay, insects and diseases. These species will also produce timbers that are durable for furniture and construction purposes such species include: *Terminalia ivorensis, Tectona grandis, Gmelina arborea* etc.

Conflicts of interest

The authors declare no conflicts of interest.

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