

# Effects Of Wood Defects On Domestic Sawn Timbers And Its Implications On Market Value In Kenema City Eastern Sierra Leone

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**ABSTRACT:** This study was conducted to identify the various defects on sawn timber in the research area, the causative agents responsible, and its implication on market value. Data was collected from 40 respondents through well-structured and pre-tested questionnaire. Data was analyzed using Statistical Package for Social Scientists and the result gathered are presented in pie chart, bar chart and tables. Result of the research shows that 35.0 % of timber defects emerges during transportation, 35% during storage, followed by processing (17.5%) and the least (12.5%) through seasoning. Highest percentage (65.0%) of timber defects occur during the dry season next to the raining season with 17.5% and those that occurs in both seasons (17.5%) falls on the same scale. It was also revealed that other forms of abnormalities such as Checks, Splits and Shakes, accounted for 40%, next was Wrapping with 20.0 %, followed by Stain and Decay 15.0 %, Knot 10.0 %, Collapse 7.5 % , Wane 5% , and Miscut 2.5% respectively. In this regard 45.0% of the timber buyers paid base on reduction in price irrespective the level of damage on the timber, while 22.5% pay if the defect is mild and low. However 32.5% were not willing to pay even if the price is reduced. In lieu of the above 57.5 % of the respondents said they experienced severe income reduction, followed by 32.5 % who indicated mild income reduction, while 10.0 % of the respondents envisaged slow income reduction. The various defects caused reduction in value chain as well as environmental threats within the study area. Conclusively the research revealed that majority of the respondents believed that the causes of timber defects is as a result of the poor transportation, improper seasoning and lack of storage facilities consequently led to poor market condition.

**Key words:** Conversion, Defects, Market values, Seasoning.

## 1. INTRODUCTION

Timber is synonymous to wood, obtained from a tree. The word is used to describe the structural components of wood suitable for various formative purposes like the construction of doors, window, roofs, partitions, beams etc. Wood is widely used because of its valuable properties, i.e. ease of working, attractive appearance, reasonable cost, non-toxic, and recyclable nature and it offers prolonged service life if it is properly protected from moisture and insects. Unfortunately, timber could naturally possess different types of defects. A defect is an irregularity or abnormality occurring inside or on the surface of the Wood or Timber which can affect its strength, appearance, durability and other properties. [1]. However, defect is simply an abnormality or irregularity found in wood. There are many different types of defects arising from many different causes. Defects may be responsible for reducing wood's economic value, lowering its strength, durability and usefulness, marring its appearance, and in some cases, causing its decay.[2] Furthermore, 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.[3]. Those abnormalities/ irregularities/ blemishes which tend to lower the economic value or decorative value of wood and also reduce the strength of wood [3] In conjunction to the above, these irregularities in timbers are broadly classified in two main categories base on the factors responsible for their causes namely: natural and artificial defects [4], for which the natural defects is caused not by man or any living organism but natural means like the wind e.g. (tension, compression) whereas the artificial defects are concern with human activities. Basically these defects are placed under various categories based on their causing agents, such as, natural, biological, conversional and seasoning defects. For natural defects are those abnormalities which develop in the standing tree naturally, difficult to control but can be minimized up to some extent e.g. knots through silvicultural operations such as pruning. For the biological defects are the abnormalities caused in a tree due to the biological agencies such as fungi, insects which is controlled by the insecticides, pesticides. Seasoning defects are the defects which are created during the seasoning of the wood e.g. bowing, check, and crook

which can be redress through appropriate seasoning method, whereas conversion defects are those defects that emerge during the process of converting wood logs and resizable timbers to the required timbers suitable for woodworking or construction projects e.g. Chip mark. [4]. There are innate defects caused by the natural characteristic of wood to shrink or expand in response to water vapor in the air. And, there are artificial and mechanical defects caused by incorrect sawing or machining (conversion), improper drying (seasoning), or improper handling and storage. Defects may be responsible for reducing wood's economic value, lowering its strength, durability and usefulness, marring its appearance, and in some cases, causing its decay. [2] Quality of wood can be determined by the end users of the wood products who may think in terms of aesthetics – workability and serviceability for end use. Serviceability relates to the 'goodness of fit' characteristics of the product in use, i.e. how well a particular attribute performs throughout the life time of the product. Product quality attributes must therefore be long lasting, as most solid wood products are not single-use items, but relatively enduring. Changes in product quality over time – stability, appearance, chemical composition and durability – can have consequences in use. [5] Meanwhile these defects on sawn timbers have caused a lot of marketing implication for timber vendors and even customers in Kenema city and Sierra Leone at large. Facing the price of these sawn timbers that has defects cause price reduction due to sub quality appearance of the timbers, sometimes it takes longer time for the customers to buy it as scraps whereas sometimes they don't [6]. The objectives of this research was to identify the various defects on sawn timber in the research area, the causative agents responsible, as well as to examine the market values attached to timber defects

## 2. Methodology

### 2.1 Research Design

The research design for this study was a descriptive survey type, designed to look into the effects of wood defects on domestic sawn timbers and its implications on

market value in Kenema City Eastern Sierra Leone The design was appropriate because it focused on observation and perception of the existing situation described and interpreted what was concerned with issues, conditions, practices, views, attitudes, processes, and trends which made an impact on the economic situation of domestic sown timber. A Survey research design was also used because it is a procedure in quantitative approach which helps to administer questionnaire in order to identify trends in the attitudes, opinion, behaviour, or characteristics of the population. At the same time, this study employed qualitative technique to answer and understand the impact of the extension approaches [7].

### 2.2 Description of study area

Kenema is the third largest city in Sierra Leone (after Freetown and Bo), and the largest city in the country's Eastern Province. It is the capital of Kenema District and a major economic center of the Eastern Province. At the 2015 national census, Kenema had a population of 200,354 [8]. Kenema is located approximately 200 miles from Freetown, and 60 kilometres (40 mi) south of Bo. Kenema lies approximately 300 kilometers (185 miles) south-east of Freetown and about 60 kilometers (40 mi) south of Bo. The rainfall intensity in the district ranges from 2001mm to 3000 mm per year. It is an important agricultural marketing center 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 is one of the most ethnically diverse 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. [8] All the dealer stores and timber sales agents completed the questionnaires. This number of respondents makes about 7.5% average sampling intensity. I.e. sampling intensity = sample size/ total got from survey.

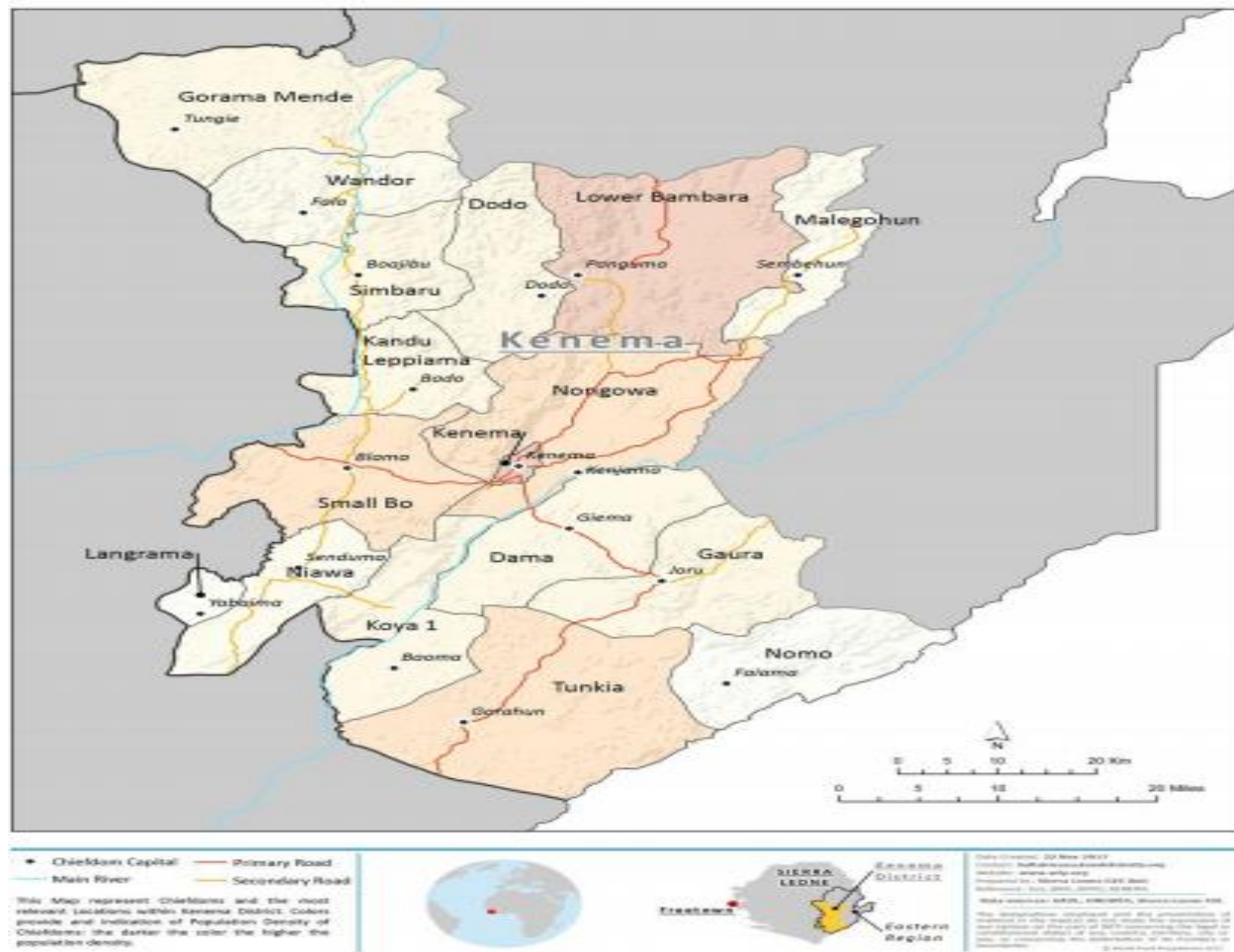


FIGURE 1: MAP OF STUDY AREA

### 2.3 Study materials

The following materials and techniques were used during the study: questionnaires, personal interview, personal observations, HB pencil and pens.

### 2.4 Sample size and selection of respondents

A preliminary survey was done in Kenema city (16<sup>th</sup> and 30<sup>th</sup> July 2021) from which respondents were selected from seven sales point including Coker jah street, Cow yard, Show field, Sumaila street, Mission road by Famata street, Dama road and R.T.I. Thirty (30) timber vendors were targeted and 10 timber dealers in total from these sales points that sum up to (40) forty respondents (Sampling level, 10% for timber vendors and 5% for timber dealers' agents) were targeted for sampling. All the timber vendors and timber dealer agents completed the questionnaires. Main while 7 timber vendors and 3 timbers dealers a total of ten (10) respondents were selected from Coker Jah Street which sum up to 25.0%, 3 timber vendors and 2 timber dealers each from (Mission road and R.T.I) a total of ten respondents that sum up to 25.0%, and other small sales points including Show field, Dama road and Sumaila street with 4 timber vendors and 1 timber dealer each with a total of 15 respondents which make up 37.5%, excluding Cow yard with 5 timber vendors and no timber dealer(s) that make up 12.5%. This number of respondents makes about 7.5% average sampling intensity. i.e. sampling intensity = sample size/ total obtained from survey

### 2.5 Data collection procedure

Data was collected through the administering of structured questionnaires, direct interviews and personal observations to complete the research work. The questionnaire covers the following issues: Part one (1) section A of the questionnaire implored information from respondents on the socioeconomic and demographic characteristic of the vendors and dealers. Part two (2) Section A solicited information on timber defects. Section B implored information on the causative agents of various timber defects. Section C implored information on the defects implications on market value etc.[9]

### 2.6 Sample technique

The sample technique used in collecting the data and other relevant information for the research was mainly random sampling from the various sales points. Numbers were randomly selected form the locations. This technique was employed so as to avoid bias in the selection process and also to avoid information gathering from the same direction.[9]

### 2.7 Sources of data

In accomplishing this research work, two main data sources were used, which were primary and secondary. The former was obtained from the selected vendors and dealers in the study area, and the later (secondary) from

textbooks, journals, articles published and unpublished dissertation and thesis and the internet.

### 2.8 Data analysis

Data was analyzed using SPSS which is a widely used programme 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, B. 1998) which is describe as one of "sociology's most influential books" for allowing ordinary researchers to do their own statistical analysis. The data that was collected in this research was analyzed using Statistical Package for Social Scientists (S.P.S.S., Version 25.0). This package was used to give results on the following parameters: age, sex, educational background and biological and conversional timber defects etc., which provides positive outcome of the study at the end. 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.

### 2.9 Summary and data coding

The primary data collected was analysed using statistics package for social scientists (SPSS). The variables were coded for example, 1 for male and 2 females etc. and then inputted into the SPSS database.

### 2.10 Statistics and coding of data

The inputted data was analysed using simple descriptive statistics. Tables were used in the presentation and discussions of the results obtained to meet the specific objectives of the study. The results were used to analyse the data collected in sample statistics, percentage calculations and tables.

### 2.11 Interpretation of statistics

The results were presented in tables and figures for discussions. Both results were interpreted using frequencies and percentages, and further descriptions done.

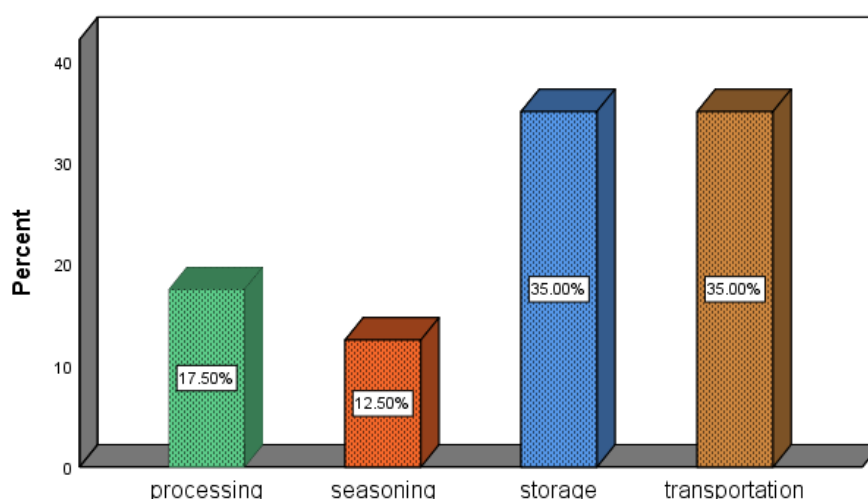
### 2.12 Presentation of results

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

## 3. RESULTS

Research findings indicate that a number of factors influence the market value of timber

### Various timber defects



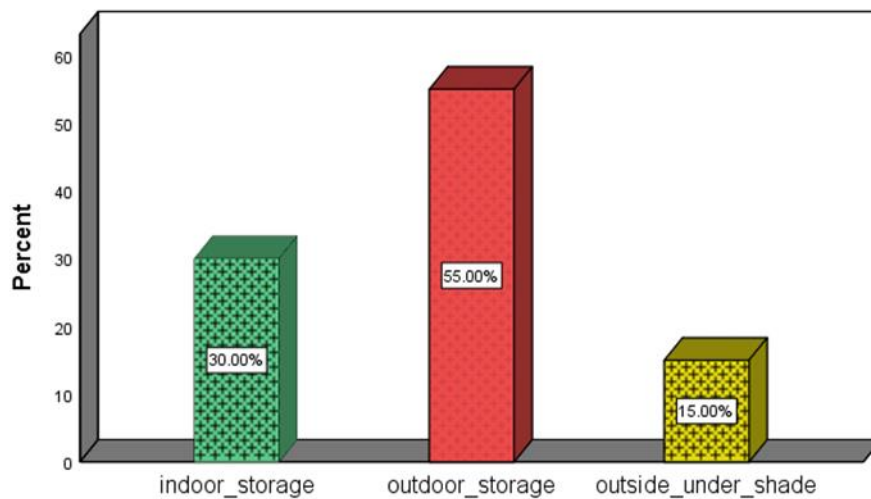
**FIGURE 2: DEFECTS APPEARING PERIOD**

Figure 2 above shows that 35.0 % of timber defects emerge each during transportation and both are on the same scale, followed by processing with 17.5% and the least was seasoning 12.5% .

**TABLE1: TYPES OF TIMBER DEFECTS IN THE MARKET**

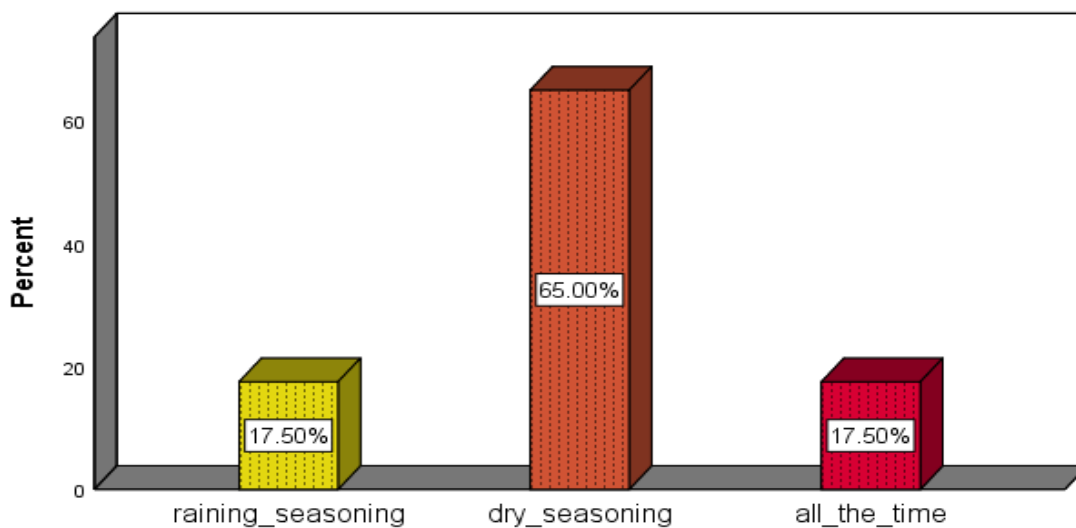
Names	Frequency	Percent	Valid %	Cumulative %
Wrapping	8	20.0	20.0	20.0
Collapase	3	7.5	7.5	27.5
Miscut	1	2.5	2.5	30.0
Wane	2	5.0	5.0	35.0
checks, split, shakes	16	40.0	40.0	75.0
Stain ,decay	6	15.0	15.0	90.0
Knots	4	10.0	10.0	100.0
Total	40	100.0	100.0	

Table 1 shows that 40.0 % of the defects are Checks, Splits and Shakes, next is Wrapping with 20.0 % followed by Stain and Decay with 15.0 %, Knot 10.0 % , followed by Collapase 7.5 % , Wane and Miscut represent 5.0% and 2.5% respectively



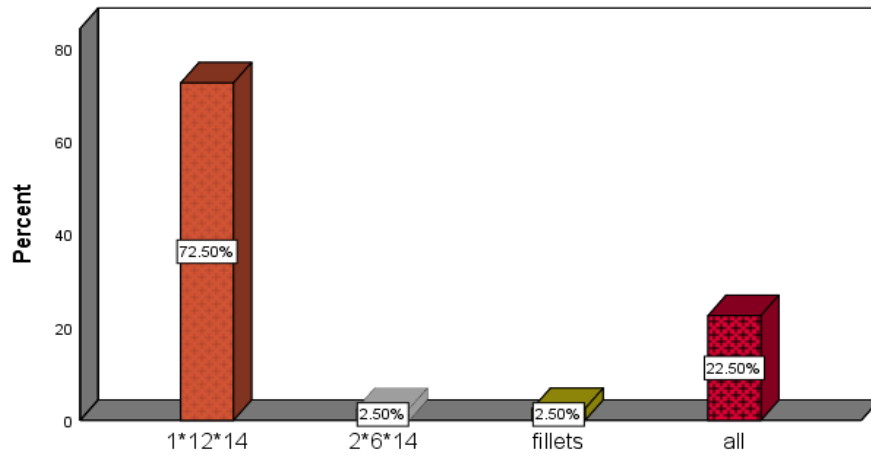
**FIGURE 3: TIMBER STORAGE CONDITONS**

Figure3 above shows that, 55.0 % of the respondents stored their timbers under outdoor storage conditions, because they lack structures for timbers to be stored so they are packed outside in an open space. 30.0 % provides indoor storage facilities, 15.0 %, under shade storage conditions to avoid defects



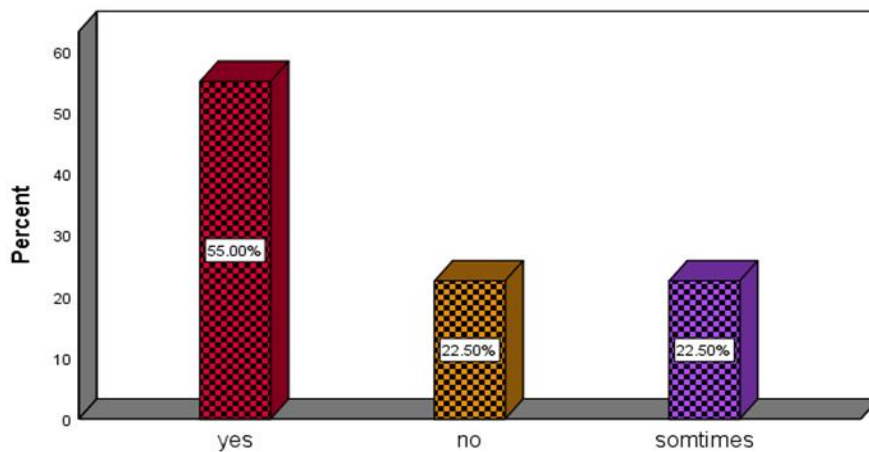
**FIGURE 4: SEASON IN THE YEAR DEFECTS OCCURS**

Figure 4 shows that, the highest percentage of timber defects occur during the dry season with 65.0% next in the raining season with 17.5% and those that occurs in both seasons also represent 17.5% which falls on the same scale.



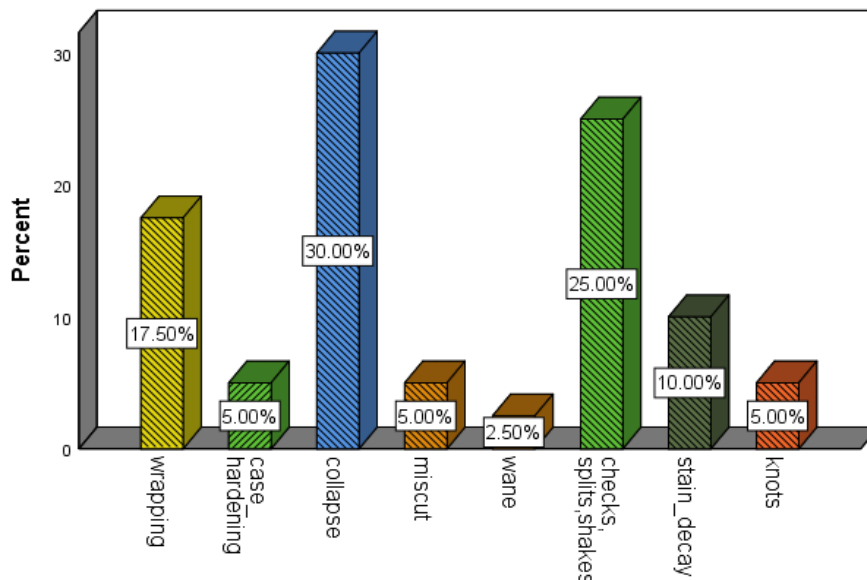
**FIGURE 5: DIMENSIONS OF TIMBERS THST IS MOSTLY AFFECTED BY DEFECTS**

Figure 5 shows that, the highest percentage of timber dimensions that is affected by defects is 1x12x14 (1 inch) with 72.5 %, next is all sizes with 22.5 % as the second highest, followed by 2x6x14 and Fillets with 2.5 % each as the least mentioned respectively



**FIGURE6: WILINESS TO PAY**

Figure 6 shows, 55% of the respondents says customers are willing to pay for defected timbers, 22.5% of the respondents says no, whilst 22.5% says they sometimes pay for defected timbers.



**FIGURE7: DEFECTS DIFFICULT TO MANAGE**

Figure 7 shows that Collapse is highest difficult defect to manage with 30.0%, followed by Checks, Splits and Shakes with 25%, next is Wrapping with 17.5 %, followed by Stain and Decay with 10.0%, next is Knots, Case

hardening and Miscuts represent 5.0% each, followed by Wane with 2.5% This implies that collapse is more difficult to manage as the timber in such condition are difficult to sell

**TABLE2: RESULT OF CAUSATIVE AGENT**

NO	CAUSATIVE AGENTS	FREQUENCY	%
1	Natural and Biological	2	5.0
2	Natural, Conversional and Seasoning	4	10.0
3	Natural and Conversional	3	7.5
4	Biological and Seasoning	1	2.5
5	Biological and conversion	3	7.5
6	Natural and Seasoning	1	2.5
7	Natural Biological and Conversion	6	15.0
8	conversional and seasoning	8	20.0
9	All	8	20.0
10	Natural Biological Seasoning	2	5.0
11	Biological conversion and seasoning	2	5.0
	TOTAL	40	100.0

Table2 shows that 20.0 % defects are caused by conversional and seasoning causative agents. Natural, biological and conversion is 15.0 % , followed by natural, conversional and seasoning with 10.0 %, natural and conversional and biological and conversional accounted

for 7.5 % each, followed by natural ,biological and seasoning agents, biological conversional agents both represent 5.0 % each, natural and seasoning, natural and seasoning with 2.5 % each.

**TABLE 3: RATE OF PRICE DEDUCTION ON DEFECTS TIMBERS**

REDUCTION IN INCOME EARNING	
Rate	Percentage (%)
Severely	57.5 %
Mildly	32.5 %
Lowly	10.0 %
Total	100%

Table 3 shows that, 57.5 % of the respondents indicates that there earning income reduces severely, followed by 32.5 % which indicates that there earning income reduces

mildly, finally 10.0 % of the respondents indicates that there earning income reduces lowly.

**TABLE 4: BIOLOGICAL CAUSATIVE AGENTS**

Biological causative agents	
Names	Percentage (%)
Termites	45. %
Fungi	10 %
Timber borers	20 %
Timber beetles	25 %
<b>Total</b>	<b>100 %</b>

Table 4 revealed that termites are the highest [45.0%] infesting agents of timber, followed by timber beetles [25%] and borers [20%]. The least represent fungi [10%].

**TABLE5: REDUCTION IN INCOME EARNING**

REDUCTION IN INCOME EARNING	
Rate	Percentage (%)
Severely	57.5 %
Mildly	32.5 %
Lowly	10.0 %
Total	100%

Table 5 shows that, 57.5 % of the respondents indicates that their earning income reduces severely, followed by 32.5 % which indicates that their earning income reduces mildly, finally 10.0 % of the respondents indicates that their earning income reduces lowly.

#### 4. DISCUSSION

From the result it shows that 35.0 % of timber defects emerge during transportation, and this is also experienced during storage (35%). Processing accounted for 17.5%, while seasoning is 12.5%. This implies that the defects that are more noticeable in the timber market occur during transportation and storage period. (Figure 2) The result further revealed that 40.0 % of the defects on the timbers are Checks, Splits and Shakes. Wrapping defect accounts for 20.0 % , followed by Stain and Decay 15.0 % . Knots defect is 10.0 % , Collapse 7.5 % , Wane and Miscut represent 5.0% and 2.5% respectively. These defects came about as a result of shock received during transporting, and long duration of timber storage. Checks, splits and shakes are the common defects in the market with 40 % which may be as a result of juvenile trees ripped as boards. Wrapping defect which represents 20% is as a result of the lack of seasoning facilities and inappropriate seasoning methods. Decay and stain emerged during growth and storage especially in young trees that are ripped as boards (table 1). This result is in accordance with studies carried out by University of Maryland Extension, 2018 to 2021.[10] Timbers are stored under outdoor storage conditions, indoor storage, and under shade which represent 55.0 % , 30.0 % and 15.0 % respectively. Sixty five percent (65.0% ) of the timber defects occur in the dries, 17.5% occur during raining season. This shows that defects occur more rapidly in the dries because it is easy for the timbers to lose moisture content which may lead to deformation of timbers at a faster rate. With regard to timber size research shows that 1x12x14 inch (1 inch) boards are mostly affected [72.5 %], this is followed by 2x6x14 inches [22.5 %] and the least size affected is the thin type known as Fillets [2.5 %] [Figure 5]. The result further, revealed that Collapse is the most difficult defect to manage, followed by Checks, Splits and Shakes next to Wrapping followed by Stain and Decay, next to Knots, Case hardenings and Miscuts. This indicates that, stored wet timbers lose water rapidly during the dries and this causes shrinkage subsequently result to an irregular shape forms.

#### 5. RESULT OF CAUSITIVE AGENTS

The findings also revealed that four main causative agents are known for timber defects in the market namely Biological, Conversional, Natural and Seasoning. Conversional and seasoning causative agents account for 20%. Natural and biological causative agents represent 15% which is as a result of the harvesting of immature and highly ageing trees, whereas biological defects mostly occurs during outdoor storage, in that regard the timbers are prone to termites infestation particularly when the timber are piled or packed on the floor which increases termites infestation and when it rains it may cause wood rots which is aided by bacteria and fungi. [11] Table 4 shows that, the highest biological causative agents are Termite with 45.0% followed by Timber beetles with 25 % , Timber borers with 20 % and Fungi 10 % . This implies

that termites are the most biological causative agents, as timbers are mostly packed on floor for long time and especially when most of these sales points are having clayed floor, while beetles are as a result of the edible parts that are found on timbers especially white boards. As for borers is resulted by the softness of the timbers especially when they are packed under rain. [11]

#### 5.1 MARKET VALUE RESULT

Figure 6 shows, the willingness to pay for defected timbers which indicates that 55.0 % of the respondents agreed that customers do pay for defected timbers. While 22.5 % said customers do pay sometimes. This indicates that despite the defects, timbers are essential commodities used for various purposes. Forty five percent (45.0 %) of the consumers paid based on reduction followed by 32.5 % that are not willing to pay even if the price is reduced. However 22.5% of the respondents confirmed that consumers will pay if the defects are mild and low. This implies that timbers are highly demanded in the market and are used by local carpenter and market women to make furniture when the price is reduced. Result also shows that, 57.5 % of the respondents indicates that their earning income reduces severely, followed by 32.5 % of the respondents who indicates that their earning income reduces mildly, while 10.0 % of the respondents experienced a loss as a result of defects on the timbers.[Table 5]

#### 6. CONCLUSION

Majority of the respondents believed that the causes of timber defects is as a result of transportation, seasoning and lack of stores to keep the timbers which exposed them to bad weather conditions consequently timber defects. Respondents also indicated that the defects has caused a lot of market implications and reduced the timber value chain and income earning of timber sellers as well as causing some environmental threats within the study area.

#### 7. RECOMMENDATIONS

In as much as, sawn timbers are essential building and furniture materials, in order to prevent wood defects on timbers and implication on market value chain. The following recommendations are made:

- 1) Ministry of Agriculture and Food Security in collaboration with the Ministry of Environment and Forestry to fully educate timber sales agents about the positive effects of wood seasoning in Kenema city.
- 2) The Ministry of Environment and Forestry in cooperation with Ministry of Agriculture and Food Security should train power saw operators in tree planting and felling to reduce sawing defects.
- 3) Training of local authorities on merchantability girth limit should be done by both government and non-governmental agencies.
- 4) Government and Non-governmental Organizations should embark on the training of power saw operators, timber sellers on timber seasoning and inform them about the advantages involved in seasoning timber.



- 5) The Ministry of Environment and Forestry in cooperation with Ministry of Agriculture and Food Security to stop illegal felling by power saw operators and encourage them to float timber sawing companies after their training.
- 6) The Ministry of Environment and Forestry in cooperation with Ministry of Agriculture and Food Security to enhance the formulations of policies for forest products uses especially timbers.
- 7) Ministry of Environment and Forestry to encourage active training of youth's organization in the management and use of sawn plank for different purposes.
- 8) Government and Non-governmental Organizations should support the construction of seasoning kiln across the country in places where timbers are produced.
- 9) Ministry of Environment and Forestry should encourage timber sellers to buy wood moisture meter.
- 10) Government and Non-governmental Organizations should help in the provision of preservative chemical for timber treatment in order to ensure low level of timber defects.
- 11) Foresters and wood scientists need to be engaging in the planting of appropriate 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.
- 12) Government and Non-governmental Organizations should support the provision of good road network system for the transporting of timbers from the site to the marketing points
- 13) The Wood Science department of Njala University should establish a wood science laboratory for the assessment of different wood species in the country.

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