

**Government of the Union of Myanmar**  
**Ministry of Forestry**  
**Forest Department**



**The Utilization Potential of Teak Tops and Lops**

Thein Myint (1), B.Sc. ( For. ) ( Rgn. ), Researcher  
and  
U Win Kyi (1), B.Sc. ( Hons. ) ( Mdy. ), D.S. ( RIE ),  
M.S. ( VPI & SU ), Head of division,  
Forest Research Institute.  
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# ကျွန်းကိုင်းဖျားကိုင်းနား အသုံးချနိုင်မှုကို စူးစမ်းလေ့လာခြင်း

ဦးသိန်းမြင့် (၁)၊ B.Sc. ( For. ) ( Rgn. ) ? သုတေသနမှူး  
ဦးဝင်းကြည် (၁)၊ B.Sc. ( Hons. ) ( Mdy. ), D.S. ( RIE ), M.S. ( VPI & SU ) ?  
ဌာနမှူး  
သစ်တောသုတေသနဌာန

## စာတမ်းအကျဉ်းချုပ်

ကျွန်းသစ်များထုတ်လုပ်ရာတွင် တောထဲ၌ အလဟဿ အဖြစ်ကျန်ခဲ့သော ကျွန်းကိုင်းဖျားကိုင်းနားများ၏ ပမာဏနှင့် ၎င်းတို့၏အသုံးချနိုင်မှုများကို ဤစာတမ်းတွင် တင်ပြထားပါသည်။ ယခုလေ့လာချက်အရ ကျွန်းပင်တစ်ပင်တွင် ပျမ်းမျှခြင်းအားဖြင့် ရောင်းတန်းဝင် သစ် ၆၈. ၅ ရာခိုင်နှုန်း၊ ပယ်သစ် ၁၈. ၄ ရာခိုင်နှုန်း နှင့် ကိုင်းဖျားကိုင်းနား ၁၃. ၁ ရာခိုင်နှုန်းခန့် အသီးသီး ထွက်ရှိကြောင်း တွေ့ရှိရပါသည်။ ထို့ကြောင့် ထွက်ရှိသော ကျွန်းသစ် ပမာဏ၏ ၃၁. ၅ ရာခိုင်နှုန်း ခန့်သည် တောထဲ၌ ကျန်ခဲ့ကြောင်း တွေ့ရှိရပါသည်။ ကိုင်းဖျား ကိုင်းနားနှင့် ပယ်သစ်များမှ ခွဲစိတ် ရရှိသော သစ်ခွဲသား များကို စနစ်တကျ အခြောက်ခံကာ ပါကေး၊ မိုဇက်၊ ပရိဘောဂ စသည်များ စမ်းသပ်ပြုလုပ်ပြီး တွေ့ရှိချက်များကို တင်ပြ ထားပါသည်။

# The Utilization Potential of Teak Tops and Lops

U Thein Myint (1), B.Sc. ( For. ) ( Rgn. ), Researcher  
and  
U Win Kyi (1), B.Sc. ( Hons. ) ( Mdy. ), D.S. ( RIE ),  
M.S. ( VPI & SU ), Head of Division,  
Forest Research Institute.

## Abstract

The paper dealt with the determination of waste of teak tops and lops left in the forest after extraction. According to this study, a teak tree on the average produces 68.5 percent of marketable size, 18.4 percent of rejection and 13.1 percent of tops and lops, respectively. Thus, it shows that about 31.5 percent of the tree was left in the forest. Teak lumber obtained from tops and lops and rejection were properly dried for making parquet, mosaic and furniture and the results were discussed in this paper.

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## 1. Introduction

Teak ( *Tectona grandis* Linn. f. ) earns its worldwide reputation as one of the best all-purpose timbers not only because of its wonderful ability to hold its shape under varying weather conditions, but also for its high resistance to fungi, termites and weathering. Because of the higher quality and popularity abroad Burma's teak fetch high prices in the international market.

The Timber Corporation has been extracting an average of 400,000 tons of teak logs annually. The corporation has been extracting only the marketable logs which are selected according to their logging rules. The other portions of the tree i.e. rejected and tops and lops are left in the forests as logging residues.

The investigation now reported is an attempt to estimate the yield of teak logging residues and to find out the utility potential of teak tops and lops.

## 2. Literature Review

As no data on the yield and utility of teak tops and lops are available, literature on similar problems on eucalypt trees was reviewed.

In studies in young 4-year-old *Eucalyptus globulus* plantations in Australia, it was reported that branches accounted for 20 percent and stem for 80 percent of the weight of above-ground wood plus bark. In *Eucalyptus microtheca* plantations in the Sudan Gezira aged 8½ to 11½ year, it had been found that branches formed 4.5 percent and stems 95.5 percent of the overbark volume, both measured to 5 cm top; the trees included a number of two-and three-stemmed trees, as well as single stems. In Sicily measurements in the first coppice rotation showed that the proportion of over-bark volume to 2 to 3 cm tops contributed by branches decreased from 25 percent at age 5 years to 7.5 percent at age 10 years in *E. camaldulensis* and from 9 percent at age 5 years to 4 percent at age 10 years in *E. globulus* ( FAO, 1979 )

## 3. Materials and Methods

### 3.1 Logging

Fifteen green teak trees from Compartment No. 18 of Nagalaik Reserved Forest in Pyinmana Township were collected. In collecting these trees, the minimum girth limit at breast height was taken as 7 feet-6 inches.

Logging was carried out to each of the fifteen trees in accordance with the logging rules of the Timber Corporation given in September, 1963 ( T.C. 1963 ). The logs obtained from each tree were classified into three groups namely; marketable, rejection ( optional ) and tops and lops.

The maximum size ( mid-girth, length or volume ) adopted to the tops and lops was according to the Notification No. 2/80 of the Ministry of Agriculture and Forests ( A & F, 1980 ). According to that notification the maximum mid-girth and the maximum length of tops and lops must be below 4 feet and 10 feet respectively or the maximum volume must be below 10 cubic feet.

In this study the minimum mid-girth and the minimum length of tops and lops taken were 1 feet - 3 inches and 3 feet, respectively.

### 3.2 Conversion into Lumber

All logs including marketable, rejected, and tops and lops were carried to the Forest Research Institute, Yezin. Some of the rejected logs and some tops and lops were converted into different sizes of lumber by using Forester - 150 horizontal band mill and Ryobi ( BS- 1100-5s ) vertical band saw. The minimum size of the lumber converted was about 2" x 1". To know the recovery percentage, the lumber obtained from each and every log were recorded piece by piece.

### 3.3 Drying of Lumber

The green lumber obtained were properly dried by using semi-greenhouse type and external collector type solar lumber dryers. The thicknesses of the lumber were about 1 inch, 1½ inches and 2 inches, respectively.

### 3.4 Making Some Flooring Materials and Some Furniture

Dried lumber of sizes ( 3" x 1" ) and ( 2" x 1" ) obtained from tops and lops were sent to the furniture Industry No. (1) of the Timber Corporation, Rangoon for making mosaic, perquet and lam perquet. To investigate the recovery percentage, the total number of pieces input to the processing machines and the total number of pieces those produced were counted carefully. To know the quality, the finished produce were graded into three classes, viz first Class, Second Class and Rejection, following the prescribed grading rules.

Some furnitures such as, office table, setty, school desk, etc. were made using the lumber obtained from the rejected logs, and some low-cost furniture such as book shelve, file-rack, chairs, stools, etc. were also made by using the lumber obtained from the tops and lops.

### 3.5 Tests on The Physical Properties

To study the physical nature of the wood obtained from the rejected logs and tops and lops in comparison with that obtained from the marketable logs, tests on some of the physical properties such as, specific gravity, density and shrinkage were made.

Eight samples from each of the three classes of tree No. (2) and tree No. (8) were taken for these tests. The sizes of the samples were about 1" x 1" x 4" for the marketable logs, 1" x 1" x 3" for the rejected logs and 1" x 1" x 2" for the tops and lops. In determining the specific gravity and density the usual water displacement method was employed.

## 4. Results and Discussion

The following discussion is divided into five sections, the first is on data on yield and the second and the third consist of data on conversion and drying of the lumber. The fourth and the fifth sections discuss the results obtained from marking of flooring materials and furniture and tests on some of the physical properties.

#### **4.1 Yield on the Rejected Logs and Tops and Lops**

Some data on the logs obtained from each of the fifteen trees are given in tables (1), (2) and (3), respectively. Table (1) shows data on the marketable logs obtained from each of the fifteen trees, and tables (2) and (3) give data on the rejected logs and tops and lops. According to these tables, the minimum girth and maximum girth at breast height of the trees collected are about 7 feet-6 inches and 9 feet-9 inches, respectively.

### Data on Marketable Logs

Table - 1

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft )	Volume ( cu -ft )
1	9' - 9"	1 - 1	9' -2"	13'	68.3
		1 - 2	6' - 11"	16'	47.8
		1 - 3	5' - 11"	13'	28.5
Total		-			144.6
2	8' - 8"	2 - 1	7' - 3"	14'	46.0
		2 - 2	5' - 11"	25'	54.7
Total		-			100.7
3	7' - 11"	3 - 1	7' - 2"	15'	48.2
		3 - 2	6' - 4"	16'	40.1
		3 - 3	5' - 2"	19'	31.7
Total		-			120.0
4	8' - 4"	4 - 1	7' - 2"	19'	61.0
		4 - 2	5' - 8"	21'	42.1
Total		-			103.1
5	8' - 3"	5 - 1	6' - 8"	24'	66.7
Total		-			66.7
6	7' - 7"	6 - 1	5' - 11"	16'	35.0
		6 - 2	5' - 4"	9'	16.0
Total		-			51.0
7	7' - 10"	7 - 1	6' - 0"	20'	45.0
		7 - 2	4' - 9"	18'	25.4
Total		-			70.4
8	8' - 3"	8 - 1	7' - 7"	20'	71.7
Total		-			71.7
9	8' - 5"	9 - 1	8' - 1"	20'	81.6
		9 - 2	6' - 5"	23'	59.2
Total		-			140.8
10	7' - 6"	10 - 1	6' - 7"	24'	65.0
		10 - 2	5' - 8"	16'	36.4
Total		-			101.4
11	7' - 6"	11 - 1	5' - 4"	20'	35.6
		11 - 2	4' - 6"	19'	24.0
Total		-			59.6



### Data on Marketable Logs

Table - 1  
( Continued )

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft )	Volume ( cu -ft )
12	8' - 8"	12 - 1	8' - 0"	18'	72.0
		12- 2	6' - 10"	10'	29.2
		12 - 3	6' - 0"	12'	28.0
Total		-			129.2
13	7' - 8"	13 - 1	7' - 0"	18'	55.1
		13 - 2	6' - 0"	13'	29.3
		13 - 3	4' - 3"	13'	14.4
Total		-			98.8
14	7' - 6"	14 - 1	6' - 5"	20'	51.5
		14 - 2	5' - 9"	12'	24.8
		14 - 3	5' - 4"	8'	14.2
Total		-			90.5
15	7' - 6"	15 - 1	6' - 2"	20'	47.5
		15 - 2	5' - 4"	25'	44.4
Total		-			91.9
Grand Total		-			1440.4
Total Average	8' - 2"	-	-	-	96.0

**Yield on Rejected Logs**

Table - 2

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( cu -ft )
1	9' - 9"	1 - 1	6' - 0"	9'	20.3
		1 - 2	4' - 9"	8'	11.3
		1 - 3	4' - 2"	8'	8.6
Total					40.2
2	8' - 8"	2 - 1	3' - 11"	12'	11.5
Total					11.5
3	7' - 11"	3 - 1	4' - 6"	14'	17.7
		3 - 2	5' - 9"	6'	12.4
Total					30.1
4	8' - 4"	4 - 1	8' - 0"	6'	24.0
		4 - 2	6' - 5"	7'	18.0
		4 - 3	5' - 6"	6'	11.3
		4 - 4	5' - 6"	7'	13.3
Total					66.6
5	8' - 3"	5 - 1	5' - 11"	9'	19.7
		5 - 2	6' - 2"	6'	14.3
		5 - 3	4' - 2"	8'	8.7
		5 - 4	4' - 7"	5'	6.6
Total					49.3

### Yield on Rejected Logs

Table - 2  
( continued )

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( cu -ft )
6	7' - 7"	6 - 1	4' - 7"	5'	6.6
		6 - 2	4' - 7"	3'	3.9
Total					10.5
7	7' - 10"	7 - 1	4' - 0"	8'	8.0
		7 - 2	4' - 0"	6'	6.0
Total					14.0
8	8' - 3"	8 - 1	4' - 9"	8'	11.2
		8 - 2	4' - 5"	7'	8.5
9	8' - 5"	9 - 1	4' - 8"	10'	13.6
		9 - 2	4' - 8"	9'	12.3
Total					25.9
10	7' - 6"	10 - 1	5' - 4"	8'	14.2
		10 - 2	5' - 3"	7'	12.2
		10 - 3	5' - 5"	5'	9.2
Total					35.6
11	7' - 6"	11 - 1	3' - 3"	14'	9.2
Total					9.2

### Yield on Rejected Logs

Table - 2  
( concluded )

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( cu -ft )
12	8' - 8"	12 - 1	4' - 4"	10'	18.9
Total		-			18.9
13	7' - 8"	13 - 1	4' - 0"	10'	10.0
		13 - 2	4' - 0"	8'	8.0
Total		-			18.0
14	7' - 6"	14 - 1	4' - 7"	8'	10.5
		14 - 2	4' - 7"	5'	6.6
Total		-			17.1
15	7' - 6"	15 - 1	4' - 9"	8'	11.2
		15 - 2	4' - 5"	7'	8.5
Total		-			19.7
Grand Total	-	-	-		386.3
Total Average	8' - 2"	-	-	-	25.8

## Yield on Tops and Lops

Table - 3

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( cu -ft )
1	9' - 9"	1 - 1	3' - 3"	9'	5.8
		1 - 2	3' - 9"	8'	7.0
		1 - 3	3' - 0"	7'	3.8
		1 - 4	3' - 5"	9'	6.5
		1 - 5	2' - 0"	7'	1.8
		1 - 6	1' - 5"	8'	1.0
Total	-	-	-	-	25.9
2	8' - 8"	2 - 1	3' - 1"	6'	3.6
		2 - 2	3' - 3"	4'	2.6
		2 - 3	1' - 7"	6'	0.9
		2 - 4	2' - 11"	4'	2.1
		2 - 5	2' - 3"	4'	1.3
		2 - 6	3' - 1"	6'	3.6
		2 - 7	2' - 9"	6'	2.8
		2 - 8	1' - 5"	8'	1.0
		2 - 9	2' - 2"	6'	1.8
Total	-	-	-	-	19.7
3	7' - 11"	3 - 1	3' - 4"	6'	4.2
		3 - 2	3' - 11"	7'	6.7
		3 - 3	2' - 9"	8'	3.8
Total	-	-	-	-	14.7
4	8' - 4"	4 - 1	3' - 5"	4'	2.9
		4 - 2	2' - 10"	4'	2.0
		4 - 3	3' - 6"	4'	3.0
		4 - 4	1' - 0"	6'	0.4
Total	-	-	-	-	8.3

**Yield on Tops and Lops**Table - 3  
( Continued )

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( Cu -ft )
5	8' - 3"	5 - 1	3' - 11"	4'	3.8
		5 - 2	3' - 8"	4'	3.4
		5 - 3	2' - 4"	5'	1.7
		5 - 4	2' - 1"	4'	1.1
		5 - 5	2' - 7"	6'	2.5
		5 - 6	2' - 4"	6'	2.1
		5 - 7	1' - 6"	6'	0.8
		5 - 8	1' - 5"	6'	0.8
		5 - 9	1' - 9"	9'	1.2
Total	-	-	-	-	17.4
6	7' - 7"	6 - 1	3' - 11"	10'	5.9
		6 - 2	2' - 8"	10'	4.4
		6 - 3	2' - 8"	11'	4.9
		6 - 4	2' - 8"	10'	4.4
		6 - 5	1' - 6"	13'	1.8
		6 - 6	2' - 0"	6'	1.5
		6 - 7	1' - 8"	12'	2.1
		6 - 8	1 - 3"	7'	0.7
Total	-	-	-	-	25.7
7	7' - 10"	7 - 1	2' - 6"	4'	1.6
		7 - 2	2' - 6"	10'	3.9
Total	-	-	-	-	5.5
8	8' - 3"	8 - 1	3' - 3"	11'	7.3
		8 - 2	2' - 9"	5'	2.4
		8 - 3	3' - 0"	4'	2.3
		8 - 4	2' - 9"	4'	1.9
		8 - 5	1' - 7"	9'	1.1
		8 - 6	2' - 2"	5'	1.5
		8 - 7	1' - 11"	5'	1.1
		8 - 8	2' - 2"	6'	1.8
		8 - 9	2' - 1"	4'	1.1
		8 - 10	1' - 7"	7'	1.1
Total	-	-	-	-	21.6

**Yield on Tops and Lops**Table - 3  
( Continued )

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( Cu -ft )
9	8' - 5"	9 - 1	1' - 7"	9'	1.4
		9 - 2	2' - 4"	10'	3.4
		9 - 3	1' - 9"	6'	1.1
		9 - 4	3' - 6"	7'	5.4
		9 - 5	2' - 9"	5'	2.4
		9 - 6	3' - 0"	4'	2.3
<b>Total</b>		-			16.0
10	7' - 6"	10 - 1	3' - 9"	11'	9.7
		10 - 2	2' - 11"	10'	5.3
		10 - 3	2' - 11"	7'	3.7
		10 - 4	2' - 3"	11'	3.5
		10 - 5	2' - 0"	11'	2.8
		10 - 6	1' - 9"	7'	1.3
		10 - 7	1' - 7"	5'	0.8
<b>Total</b>		-			27.1
11	7' - 6"	11 - 1	2' - 10"	11'	5.5
		11 - 2	1' - 11"	11'	2.5
		11 - 3	1' - 10"	8'	1.7
<b>Total</b>		-			9.7
12	8' - 8"	12 - 1	2' - 9"	4'	1.9
		12 - 2	1' - 7"	15'	2.4
		12 - 3	3' - 11"	12'	11.7
		12 - 4	3' - 4"	3'	2.1
		12 - 5	1' - 10"	7'	1.5
		12 - 6	2' - 8"	6'	2.7
		12 - 7	2' - 5"	5'	1.8
		12 - 8	3' - 1"	7'	4.2
		12 - 9	3' - 0"	8'	4.3
		12 - 10	2' - 2"	9'	3.6
<b>Total</b>					36.2

### Yield on Tops and Lops

Table - 3  
( Continued )

Tree No.	Girth at Breast Height ( ft-in )	Log No.	Mid-Girth ( ft-in )	Length (ft-in )	Volume ( Cu -ft )
13	7' - 8"	13 - 1	2' - 4"	5'	1.7
		13 - 2	2' - 9"	9'	4.3
		13 - 3	2' - 6"	13'	5.1
		13 - 4	1' - 11"	5'	1.1
		13 - 5	2' - 10 "	8'	4.0
		13 - 6	2' - 1"	9'	2.4
Total	-	-	-	-	18.6
14	7' - 6"	14 - 1	2' - 7"	10'	4.2
		14 - 2	2' - 9"	9'	4.3
Total	-	-	-	-	8.5
15	7' - 6"	15 - 1	2' - 2"	14'	4.1
		15 - 2	1' - 7"	8'	1.3
		15 - 3	2' - 2'	6'	1.8
		15 - 4	1' - 8"	7'	1.2
		15 - 5	1' - 9"	13'	2.5
		15 - 6	2' - 7"	5'	2.1
		15 - 7	1' - 9"	12	2.3
		15 - 8	3' - 5"	6'	4.4
		15 - 9	2' - 9"	4'	1.9
Total	-	-	-	-	21.6
Grand Total	-	-	-	-	276.5
Total Average	8' - 2"	-	-	-	18.4

These tables also show that a teak tree on the average produced 96.0 cubic feet, 25.8 cubic feet and 18.4 cubic feet in volume from marketable logs, rejected logs and tops and lops, respectively.

Table (4) gives the data on yield from each of the three groups of the logs obtained from a tree. According to this table, a teak tree on the average produces 68.5 percent of marketable size, 18.4 percent of rejection and 13.1 percent of tops and lops. Thus, it shows that about 31.1 percent of the tree was left in the forest. Since the Timber Corporation has been extracting about 400,000 tons of teak logs yearly, from this study it is estimated that about 184, 000 tons of teak were left in the forest yearly. However, since the present study covered only 15 teak trees, the results obtained may not be conclusive for application to the entire teak extraction works. Nevertheless, the present study is the first of its kind and the finding had a strong indication on the extent in which a great percentage of usable teak lumber had been left in the forest, which, if appropriately utilized, has a tremendous utility potential.



## 4.2 Data on Conversion of Lumber

The total volume of the rejection logs and that of tops and lops converted into lumber together with the total volume of different sizes of lumber recovered.

**Table - 4 Yield on Marketable Logs, Rejected Logs and Tops and Lops**

Tree No.	Yield on Marketable		Yield on Rejected		Yield on Tops & Lops		Total
	Volume ( cu-ft )	Percentage	Volume	Percentage	Volume	Percentage	Yield ( cu-ft )
1	144.6	68.6	40.2	19.1	25.9	12.3	210.7
2	100.7	76.3	11.5	8.7	19.7	15.0	131.9
3	120.0	72.8	30.1	18.2	14.7	9.0	164.8
4	103.1	57.9	66.6	37.3	8.3	4.8	178.0
5	66.7	50.0	49.3	37.0	17.4	13.0	133.4
6	51.0	58.5	10.5	12.0	25.7	29.5	87.2
7	70.4	78.3	14.0	15.6	5.5	6.1	89.9
8	71.7	51.5	19.7	14.8	21.6	16.2	113.0
9	140.8	77.1	25.9	14.2	16.0	8.7	182.7
10	101.4	61.8	35.6	21.7	27.1	16.5	164.1
11	59.6	75.9	9.2	11.7	9.7	12.4	78.5
12	129.2	70.1	18.9	10.3	36.2	19.6	184.3
13	98.8	73.0	18.0	13.3	18.6	13.7	135.4
14	90.5	78.0	17.1	14.7	8.5	7.3	116.1
15	91.9	69.0	19.7	14.8	21.6	16.2	133.2
Total	1440.4	-	386.3	-	276.5	-	2103.2
Average	96.0	68.5	25.8	18.4	18.4	13.1	140.2

from each of the two classes are given in table (5). The table shows that, the average recovery from rejection logs is about 55 percent, whereas from tops and lops is about 42 percent. Thus the over all minimum recovery percentage of lumber from logs left after extraction may be estimated as 40.



According to the previous discussion on yield, it had been estimated that about 184,000 tons of log were left in the forest yearly. If ways and means to extract this timber economically can be found, a minimum of about 73,600 tons of teak lumber annually can be salvaged out of logs left behind after the extraction. If we put the market value of rejection teak at K 1500/- per ton, about K 110,40,000 worth of lumber is left annually in the forest, which could be put into utility with great beneficial effect.

## 4.3 Drying Behaviour

The average initial moisture content of green lumber which were solar dried was about 48.0 percent. The drying times varied from 20 to 40 days depending on the thicknesses of the lumber. The average final moisture content was about 8.0 percent.

No surface checking, distortion, collapsing, honey-combing or case-hardening occurred. However, slight warping occurred in some of the boards, especially in the boards which were converted from tops and lops.

**Table-5 Lumber Recovery of Rejected Logs and Tops & Lops**

Log Class	Volume of Logs Converted ( cu-ft )	Different Sizes of Lumber ( inch x inch )	Total Volume of Lumber ( cu-ft )	Average Recovery( % )
Rejected	125.0	4 x 2, 3 x 2, 2 x 2, 18 x 1, 12 x 1, 10 x 1 8 x 1, 6 x 1, 2 x 1	69.3	55.4
Tops & Lops	162.0	4 x 2, 2 x 2, 3 x 1 ½, 6 x 1, 4 x 1, 3 x 1  , 2  x 6/8, 1 ½ x 1 ½	68.0	42.0

#### 4.4. Data on Flooring Materials and Some Furniture

Data obtained from teak made into three different kinds of flooring materials are given in table ( 6 ). It shows that, the recovery percentage of each kind of the flooring materials is about 80. This figure is almost the same as the standard recovery percentage of the Furniture Industry No. ( 1 ). The factory is producing all kinds of teak flooring materials and, their standard recovery percentage is about 80 to 85.

According to that table, it can be seen that the total number of pieces rejected for parquet and lam parquet are about 75 percent and 48 percent respective of the total number of pieces produced. However, out of the total pieces of 1636 mosaic produced only 67 pieces were rejected. This, it will be more economical for tops and lops to make mosaic rather than parquet and lam parquet.

In making furniture by using lumber obtained from rejection logs, it was learnt that the working properties, such as cutting planing, boring, turning, mortising, sanding, polishing of the wood were the same as those of normal teak. In making low-cost furniture using lumber obtained from tops and lops, it was learnt that the working properties of tops and lops wood was not the same as that of the normal teak. It was difficult to cut. Planing, turning, mortising and polishing are different because of the presence of several knots. However, for low-cost furniture, wood from teak tops and lops will serve the purpose as quality is not the prime objective.

**Table - 6. Data on the Flooring materials**

Kind of Flooring Material	Size ( inch )	Total Input ( no )	Total Output				Recovery Percentage
			class I ( no )	Class II ( no )	Reject ( no )	Total ( no )	
Mosaic	1 x 5/16 x 4	2037	1233	336	67	1636	80.3
Parquet	2 x 7/8 x 7/8 x 8	920	72	103	522	697	75.8
Lam Parquet	2 x 12	1100	232	200	488	1020	83.6

#### 4.5. Some Physical Properties

Table ( 7 ) represents some of the Physical Properties of the marketable logs, rejected logs and tops and lops, respectively. Some physical properties of Pyinkado ( *Xylia dolarbriformis* ) and Ingyin ( *Pentacame siamensis* ) are also given for comparison. Figures for Pyinkado and Ingyin were obtained from testes carried out at the Forest Research Institute, Dehar Dun, India ( Rodger, 1963 ).

According to that table, figure for the specific gravity ( both green and oven-dry ) of each of the three classes are not significantly different.

The suitability of wood for utilization is decided from the dimensional stability of the timber as shown in the ratio of the tangential shrinkage to radial shrinkage ( T/R ). Wood best suited for specific utility has dimensional stability with a low T/R ratio and low absolute transverse dimensional changes ( Panshin, 1980 ). In table ( 7 ), it is found that the T/R ratio of teak tops and lops is almost similar to that of the marketable teak logs. The radial shrinkage of teak tops and lops are also not too different with those of the marketable teak logs.

Compared to the other species, the radial and tangential shrinkage of teak tops and lops are lower than those given for Pyinkado and Ingyin.

**Table - 7. Some Physical Properties of Marketable Teak Logs, Rejected Teaklogs, Teak Tops and Lops and Other Species**

Name	Moisture Content 9 (%)	Specific Gravity	Weight Density (lb ft <sup>-3</sup> )	Shrinkage ( green to ovendry )		Dimensional Stability ( Tgt. Shr. / Rad. Shr. )
				Radial (%)	Tangential (%)	
Marketable	50.8	0.600 ( G ) 0.675 ( OD )	56.7 ( G )	2.6	5.2	2.00
Rejected	61.8	0.604 ( G ) 0.663 ( OD )	61.8 ( G )	2.7	6.1	2.26
Tops & Lops	65.7	0.673 ( G ) 0.706 ( OD )	69.3 ( G )	2.9	6.2	2.14
Pyinkado*	48.6	0.779 ( G ) 0.816 ( A )	72.0 ( G )	3.3	6.7	2.03
Ingyin**	54.3	0.779 ( G ) 0.819 ( A )	75.0 ( G )	4.8	8.9	1.85

G - Green  
OD - Ovendry  
A - Airdty

\* Xylia dolarbriformis  
\*\* Pentacme siamensis

## 5. Conclusion

Conclusions drawn from this study are :

- (1) A teak tree on the average produces 68.5 percent of marketable lumber, 18.4 percent of rejection, and 13.1 percent of tops and lops, respectively. Thus, 31.5 percent of teak tree is left in the forest.
- (2) It is estimated that out of 400,000 tons of teak extracted annually, about 184,000 tons in the form of rejection and tops and lops, are left in the forest.
- (3) The recovery percentage of lumber converted from the teak tops and lops is about 40.
- (4) Wood obtained from teak tops and lops is suitable for making mosaic flooring and low-cost furniture.
- (5) Specific gravity and shrinkage of teak tops and lops are not significantly different from those of the marketable teak logs.

## References

1. Bryant, B.S. 1980. Utilization of Tropical Forestry Residues for social and Economic Benefits. ( Based on a presentation made to the production group of COHDEFOR, Tegucigalpa, Honduras, Nov. 28, 1980).
2. Food and Agriculture Organization ( FAO ), 1979. Eucalyptus for Planting. Food and Agriculture Organization of the United Nations, Rome. FAO Forestry Series No. 11, 677 pp.
3. Forest Department ( F.D. ), 1939. Classification of Teak Logs. ( For departmental use only ). 40 pp.
4. Forest Department ( F.D. ) 1941. Logging Rules and standard for Jungle Rejection of Teak Logs. The Bombay Burma Press, 26, 29<sup>th</sup> St. Rangoon. 28 pp.
5. Ministry of Agriculture and Forests ( A & F ), 1978. Notification No. 1/78, Dated 11<sup>th</sup> April, 1978.
6. Ministry of Agriculture and Forests ( A & F ), 1978. Notification No. 2/78, Dated 4<sup>th</sup> April, 1978.
7. Ministry of Agriculture and Forests ( A & F ), 1980. Notification No. 2/80, Dated 24<sup>th</sup> Nov, 1980.
8. Panshin, A.J. & C. dezeuw, 1980. Textbook of Wood Technology. McGraw-Hill, New York. 722 pp.
9. Puttock, G.D., 1987. The Economics of Collecting and Processing whole-tree Chips and . Logging Residues for Energy. For. Prod.J. Vol.37, No.6; June, 1987. pp. 15 - 20.
10. Timber Corporation ( T.C. ) 1963. Departmental Instruction No. 97. Dated 1<sup>st</sup> Oct. 1963.