

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



**Evaluation of Regional Yield of Planted
Teak in Prome Forest Division**

by
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ပြည်သစ်တောနယ်ရှိ ကျွန်းစိုက်ခင်းများ၏အထွက်နှုန်းကို လေ့လာခန့်မှန်းခြင်း

ဦးစောဝင်း

သစ်တောသုတေသနဌာနခွဲ
သစ်တောသုတေသနဗိမ္မာန်

စာတမ်းအကျဉ်းချုပ်

မြန်မာနိုင်ငံတွင် ကျွန်းစိုက်ခင်းများကို တနှစ်ထက်တနှစ်တိုးချဲ့ တည်ထောင်လျက်ရှိရာ၊ စီမံကိန်းများ ရေးဆွဲရန်အတွက်၊ ကျွန်းစိုက်ခင်းများ၏ တဧကအထွက်နှုန်းကို သိရှိရန်လိုအပ်ပါသည်။

ကျွန်းစိုက်ခင်းများ၏အထွက်နှုန်းကို ပဏာမလေ့လာခြင်းအနေဖြင့် ပြည်သစ်တောနယ်ရှိ သက်ကြီးကျွန်းစိုက်ခင်း အချို့နှင့် သက်ငယ်ကျွန်းစိုက်ခင်း အချို့ကို လေ့လာခဲ့ရာ၊ လက်ရှိ တဧကအထွက်နှုန်းမှာ ကျွန်းတောတွက်ဇယားတွင် ဖော်ပြထားသည့် ထုထယ်ထက်လည်းကောင်း၊ ဖြတ်ပုံ ဧရိယာထက်လည်းကောင်း၊ များစွာလျော့နည်းလျက်ရှိကြောင်း တွေ့ရှိရပါသည်။

Evaluation of regional yield of planted Teak in Prome Forest Division

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Abstracts

As teak plantation programme acceleration in Burma, it is felt that per acre yield from these plantation should be assessed for planning purpose. As a preliminary step, yield studies on some young and old teak plantations in Prome forest division have been carried out and the results indicate that the present yield in terms of volume and basal area is much lower than that in the yield tables.

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1. Introduction

Commencing from the third four year plan period teak plantations are formed extensively in Burma and as teak plantation programme accelerates it is felt that per acre yield from these plantations should be assessed for planning purposes.

As a preliminary step, the yield studies in some young and old teak plantations have been carried out in Prome forest division and the results are compared with those of the India – Burma Teak Yield Tables.

2. Study Area

From the existing teak plantations in the Prome forest division plantations in Middle and South Nawin Reserves were selected for this study. Generally, plantations in the Middle Nawin Reserve are old (aged 60 years and above) and those in the South Nawin Reserve are much younger (aged less than 20 years). Unfortunately, plantations of age between these two classes are absent.

3. Sampling Design and Selection of Sampling Units

There are altogether 18 plantations in the area. Eight plantations: age between 10 to 20 years and ten plantations 60 to 70 years in age were arranged in random order. Three and five first-stage units were selected with probability proportional to size (area of the plantation), without replacement, in the young and old plantations respectively.

Descriptions of the plantations selected for growth and yield studies are shown in (Table 1). Maps showing these areas are also attached.

Table 1. Extent of teak plantations selected for growth and yield studies

Serial No.	Reserve	Compartment	Age	Plantation area (acres)
1	2	3	4	5
1	South Nawin	1	15	100
2	South Nawin	48	10	85
3	South Nawin	50	13	35
4	South Nawin	20	61	60
5	Middle Nawin	5	62	58
6	Middle Nawin	7	60	374
7	Middle Nawin	8	60	35
8	Middle Nawin	4	62	42

Plantations with age between 10 and 20 years both inclusive, are treated as young plantations and those with age 60 years and above are treated as old plantations.

Within each selected first-stage unit (or plantation), a random point was located to lay out a cluster of these circular plots at an interval of 1000' on a line running either N- S or E – W.

The size of a circular plot was 0.1 acre (37'3" radius) in young plantations and 0.2 acre (52'8" radius) in old plantations.

4. Field Work

On each circular the following measurements were taken.

- 1) Girth at breast height of all teak trees
- 2) Total height of the largest tree (to estimate top height of the plantation for of classification)
- 3) Total heights of three teak trees having girth approximately equivalent to the mean girth of the crop.
- 4) Age.

A crew consisting of 1 Assistant Director, 1 Deputy Ranger and 1 Forester had carried out the field work during March 1980.

5. Analysis of the Data

Based on the enumeration figure, the following computations are carried out.

- 1) Determination of site quality of each plot based on age and top height.
- 2) Estimation of number of trees per acre by dividing number of trees on the plot by its area.
- 3) Estimation of volume per plot by applying appropriate tree volume functions and calculation of per acre volume from plot data.
- 4) Determination of mean annual increment (stem timber) by dividing total volume by age.
- 5) Multiple regression analysis between various tree and stand parameters.

Some results of the analysis of the field data are presented in table2.

Table 2. Some results of the analysis of the data collected in teak plantations

Reserve	Compartment	Sampling unit No.	Age	Number per acre	Average dia. (inch)	Average height (ft)	Basal area per acre (sq.ft)	Volume per acre (c.ft)	Site quality
South Nawin	1	1	15	210	4.98	43	29.69	487	4
		2	15	80	5.40	41	13.69	137	4
		3	15	210	4.78	47	23.69	408	4
	50	4	13	190	4.10	50	18.72	260	3
		5	13	170	4.27	46	17.58	309	3
		6	13	230	4.09	42	23.48	388	3
	48	7	10	250	3.30	30	15.79	135	5
		8	10	200	2.96	27	10.38	80	5
		9	10	300	4.19	50	29.83	542	3
	20	10	61	30	14.54	87	34.86	876	3
		11	61	25	14.64	78	32.32	602	3
		12	61	40	14.00	86	44.37	1108	3
Middle Nawin	7	13	60	25	16.43	99	17.56	1113	2
		14	60	50	14.48	98	59.70	1860	2
		15	60	40	13.09	88	38.20	1062	2
	5	16	62	30	13.69	94	30.80	962	1
		17	62	30	12.47	110	26.23	1170	1
		18	62	25	14.71	127	30.46	1608	1
	8	19	60	45	13.30	108	44.37	1889	1
		20	60	30	14.27	111	34.50	1514	2
		21	60	45	14.00	101	48.85	1956	2
	4	22	62	40	17.43	101	66.75	2024	2
		23	62	45	15.14	100	57.85	1805	2
		24	62	30	15.33	96	39.30	1152	2

In tree volume estimation, the following volume function derived by Dr. Kyaw Tint, Forest Department (1980), has been applied.

$$V = 0.0000163 D^{1.2577} H^2 \text{ with } R^2 = 0.8506$$

Where $V = \text{Volume in m}^3$

$D = \text{Diameter at breast height in cm}$

& $H = \text{Total height in metres.}$

By the method of multiple regression analysis the following functions have been derived.

$$1) H = 74.4667 + 0.01154 A^2 - 1.9151 S^2 \text{ with } R^2 = 0.966$$

$$2) N = 1308.02 e^{-1.358638D} \text{ with } R^2 = 0.95$$

$$3) G = 0.005454 2 ND^2$$

- 4) $D = 2.00252 e^{0.0174714 H}$ with $R^2 = 0.88$
 5) $H = 2.3651 + 9.6861 D - 0.01391 D^3$ with $R^2 = 0.94$
 6) $V = e^{-1.7145839} G^{1.041167} H^{1.0802032}$ with $R^2 = 0.99$

Where,

- H = Top height in feet
 A = Age in years
 S = Site quality
 N = Number of trees per acre
 G = Basal area in square feet
 D = Average diameter in inches
 \bar{H} = Average height in feet
 V = Total stem volume in cu.ft. under bark.

5.1 Developing Teak Yield Tables

A computer program has been written to construct teak yield tables based on the function given above. The program involves the following steps:

- Step 1. A (age in years) and S_i (site quality classes with $i=1,2,\dots,5$) are input to predict H (crop top height) by function (i).
 Step 2. Function (iv) uses H to estimates crop mean diameter, D.
 Step 3. The value of D is substituted in function (U) to generate crop mean height, \bar{H} .
 Step 4. The N – D relationship (function (ii)) is applied to calculate the no. of trees per acre N, corresponding to the given diameter, age and site.
 Step 5. Based on N and D, function (iii) produces basal area G.
 Step 6. Finally H and G are introduced in function (vi) to forecast volume V, of the main crop.

Teak yield tables have been constructed for site qualities I to V and presented in the Appendix.

6. Discussion and Conclusion

To clearly see the difference of the yields in basal area according to the yield tables constructed by Laurie and Ram (1940) and the present study, a comparison of the two kinds of figures is presented in the diagram (see figure).

As seen from the figure the yields of teak plantations in Prome forest division derived by the current investigation are much lower than those given in the old yield tables. The main causes of significant decrease in the yield are considered to be the following –

- (1) Due to insurrection during 1940's and plantations had been almost completely ignored without being given any proper and timely treatments.
- (2) For the same reason cited in (i), teak plantations could not have been effectively protected which resulted, most probably, in quite a considerable amount of illicit fellings.

However, the results indicated by the present investigation may not be considered as truly representative of the area under study since the sample taken had been too small to cover the whole range of the age and site quality classes of the plantations prevailing in the division. Further investigations are thus deemed essential to make an assessment of the growth potentialities of planted teak with confidence.

Regional Teak Yield Table**Site Quality 1****Prome Forest Division**

Age (years)	Average Dia. (inch)	Average girth (inch)	Average height (ft.)	Dorminant height (ft.)	No. of trees	Basal area (sq.ft.)	Volume (Main Crop) (cu.ft.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10	7.26	22.81	67.35	73.71	114	32.77	906.56
15	7.44	23.37	68.73	75.15	111	33.44	946.25
20	7.71	24.22	70.18	77.17	106	34.35	1002.97
25	8.07	25.35	73.21	79.76	100	35.48	1077.53
30	8.53	26.80	76.35	82.94	393	36.77	1170.22
35	9.11	28.62	80.07	86.69	84	38.14	1297.96
40	9.82	30.85	84.32	91.02	75	39.48	1402.95
45	10.70	33.62	88.97	95.92	65	40.60	1530.48
50	11.78	37.01	93.71	101.40	55	41.25	1645.89
55	13.09	41.13	97.96	107.46	44	41.12	1721.20
60	14.70	46.18	100.56	114.10	34	39.87	1714.68

Regional Teak Yield Table**Site Quality 2****Prome Forest Division**

Age (years)	Average Dia. (inch)	Average girth (inch)	Average height (ft.)	Dorminant height (ft.)	No. of trees	Basal area (sq.ft.)	Volume (Main Crop) (cu.ft.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10	6.57	20.64	62.02	67.96	128	30.02	757.04
15	6.73	21.14	63.33	69.40	124	30.72	793.18
20	6.97	21.90	65.20	71.42	120	31.69	845.40
25	7.30	22.93	67.65	74.02	113	32.92	915.11
30	7.71	24.22	70.70	77.19	106	34.36	1003.67
35	8.24	25.89	74.37	80.94	97	35.97	1111.83
40	8.88	27.90	78.66	85.27	87	37.65	1238.62
45	9.68	30.41	83.50	90.17	77	39.24	1379.60
50	10.65	33.46	88.72	95.66	66	40.55	1524.09
55	11.84	37.20	93.36	101.71	54	41.26	1651.31
60	13.30	41.78	98.46	108.35	43	41.03	1726.32

Regional Teak Yield Table**Site Quality 3****Prome Forest Division**

Age (years)	Average Dia. (inch)	Average girth (inch)	Average height (ft.)	Dorminant height (ft.)	No. of trees	Basal area (sq.ft.)	Volume (Main Crop) (cu.ft.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10	5.55	17.44	53.78	58.38	151	25.34	544.00
15	5.70	17.91	54.96	59.83	147	26.04	573.00
20	5.90	18.54	56.66	61.85	142	27.03	615.47
25	6.17	19.38	58.89	64.44	136	28.30	673.24
30	6.53	20.51	61.71	67.62	129	29.86	748.57
35	6.97	21.90	65.15	71.37	120	31.67	843.96
40	7.51	23.59	69.25	75.69	109	33.69	961.47
45	8.19	25.73	74.03	80.60	98	35.83	1101.81
50	9.01	28.31	79.46	86.08	86	37.93	1262.28
55	10.02	31.49	85.41	92.14	73	39.78	1433.58
60	11.25	35.34	91.52	98.77	59	41.02	1572.16

Regional Teak Yield Table**Site Quality 4****Prome Forest Division**

Age (years)	Average Dia. (inch)	Average girth (inch)	Average height (ft.)	Dorminant height (ft.)	No. of trees	Basal area (sq.ft.)	Volume (Main Crop) (cu.ft.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10	4.39	13.79	43.75	44.98	182	19.17	325.52
15	4.51	14.17	44.74	46.42	179	19.80	344.84
20	4.67	14.67	46.17	48.44	174	20.69	373.50
25	4.88	15.33	48.06	51.04	168	21.87	413.20
30	5.16	16.21	50.46	54.21	161	23.35	466.27
35	5.51	17.31	53.43	57.96	152	25.14	535.70
40	5.95	18.69	57.03	62.29	141	27.25	625.06
45	6.48	20.36	61.33	67.19	130	29.65	738.24
50	7.13	22.40	66.38	72.68	116	32.29	886.34
55	7.92	24.88	72.20	78.73	102	35.04	1047.76
60	8.90	27.96	78.76	85.37	87	37.68	1241.51

Regional Teak Yield Table**Site Quality 5****Prome Forest Division**

Age (years)	Average Dia. (inch)	Average girth (inch)	Average height (ft.)	Dorminant height (ft.)	No. of trees	Basal area (sq.ft.)	Volume (Main Crop) (cu.ft.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10	3.25	10.21	33.38	27.74	219	12.65	157.67
15	3.33	10.46	34.15	29.19	216	13.13	167.91
20	3.45	10.84	35.25	31.21	212	13.81	183.25
25	3.61	11.34	36.72	33.80	207	14.73	204.83
30	3.82	12.00	38.60	36.98	200	15.92	234.26
35	4.08	12.82	40.93	40.73	192	17.40	273.80
40	4.40	13.82	43.80	45.05	182	19.20	326.49
45	4.79	15.05	47.26	49.96	171	21.37	396.30
50	5.28	16.59	51.42	55.44	158	23.93	480.20
55	5.86	18.41	56.36	61.50	143	26.86	607.97
60	6.58	20.67	62.18	68.13	127	30.11	761.32

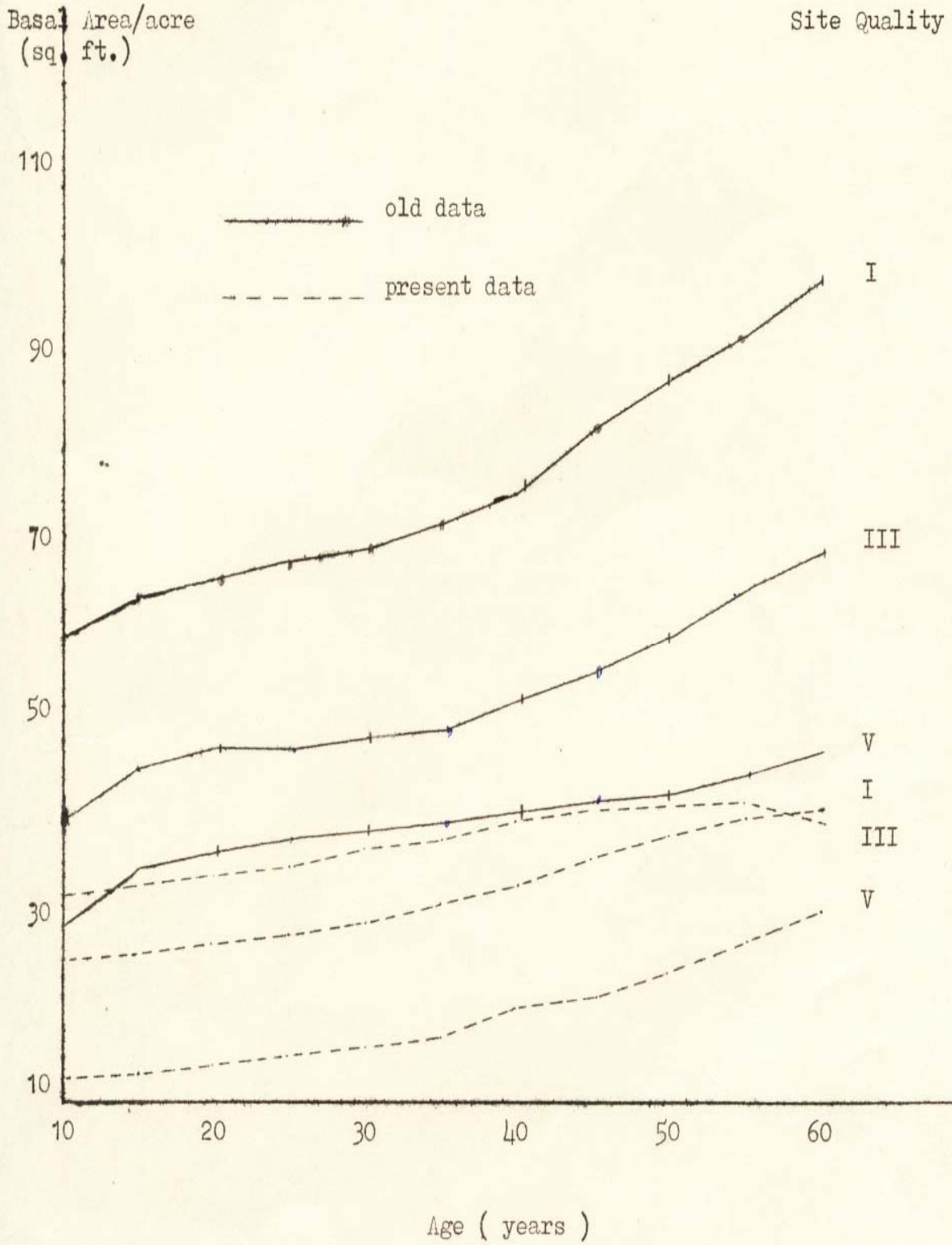
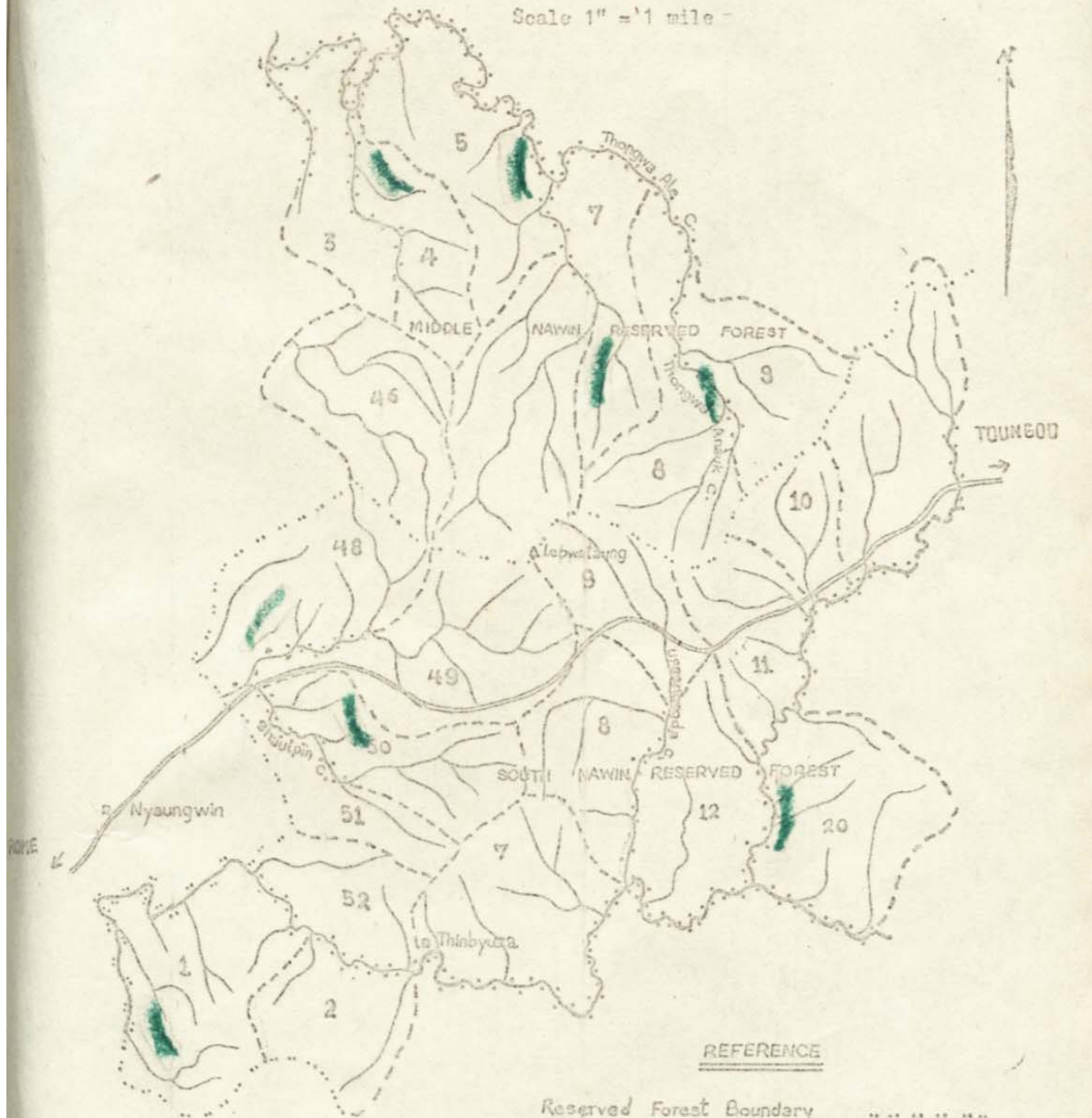


Diagram showing a comparison of old and current yield table figures.

TEAK PLANTATION INVENTORY
 PROME FOREST DIVISION - MARCH - 1980

Scale 1" = 1 mile -



REFERENCE

- Reserved Forest Boundary
- Compartment Boundary - - - - -
- Teak Plantations ■
- Sampling unit □
- Metal Road = = = = =