



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



**Physical and Mechanical Properties
of Leza (*Lagerstroemia Tomentosa* Presl.)**

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လယ်ဇေသစ်၏အရည်အချင်းနှင့်အင်အားကိုလေ့လာခြင်း

ဦးစိုးတင့်
သစ်တောထွက်ပစ္စည်းသုတေသနဌာနခွဲ
သစ်တောသုတေသနဗိမာန်

စာတမ်းအကျဉ်းချုပ်

လယ်ဇေသစ်သည်ပဲခူးရိုးမသစ်တောများတွင် မြောက်များစွာပေါက်ရောက်ပါသည်။ ကျွန်း၊ ပျဉ်းကတိုး မှလွဲ၍လယ်ဇေ၏တစ်ဧကပေါက်ရောက်နှုန်းသည် ရွှေတန်းတွင် တည်ရှိနေကြောင်းတွေ့ရှိ ရပါသည်။ သို့သော် ၎င်းကိုလူသုံးနည်းခွဲပါသည်။မြန်မာနိုင်ငံရှိလူသုံးနည်းသောသစ်များကို သင့်တော်သောနေရာများတွင်၊ ပြုပြင် အသုံးချနိုင်ရန် ရည်ရွယ်ချက်ဖြင့် လယ်ဇေသစ်၏ အရည်အချင်းနှင့် အင်အားများကို စမ်းသပ်ရှာဖွေ ဖော်ထုတ်ထားပါသည်။

Physical and Mechanical Properties of Leza.
(*Lagerstroemia tomentosa*. Presl.)

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Abstract

Leza grows abundantly in the forests of Pegu Yoma. The growing stock per acre, apart from teak and Pyinkado is quite high in these forests and yet it has been little-used. Therefore with the object of finding out the potential end uses of lesser-known species of Burma, the physical and mechanical properties of leza are tested and described.

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1. Introduction

The tropical forests of Burma are endowed with over a thousand species of woody trees, out of which only about sixty species of natural durability and strength are utilized commercially at present. Many species are left in the forest unextracted. It is hoped that these unextracted little-used or lesser-known species will have at least a particular end-use of one way or the other that will be best fitted to them. Some non-durable species after proper treatment could possibly be used as structural timber if they are strong enough. A much more detailed knowledge of these species is required for better utilization and for the exploitation of lesser-used species. To put such species into proper end use, its mechanical and physical properties have to be known. Although strength is an essential quality to find out the potential end-use of a species, other properties such as seasoning properties, workability properties, durability, anatomical structure and appearance should also be studied.

In the drive to promote better utilization, the availability of the so-called lesser-known species should also be given attention. Unless the volume available is large enough, the exploration of its end use will not be justified.

The forest inventory data carried out during the year 1969 to 1979 by the Burma Forest Department indicated that the occurrence of Leza (*Lagerstroemia tomentosa*) in greater volume is confined to North Toungoo, Pinyinana, and Yamethin Forest Divisions (Appendices I, II, III & IV). In North Toungoo Division, apart from the commercially popular species, such as Pyinkado (*Xylia dolabriformis*) and In (*Dipterocarpus tuberculata*), the growing stock of Leza. 4" & over girth at breast height (4' 6" & above ground level) is the highest. This is also true for growing stock 2" & over girth. In Pinyinana Forest Division, Leza stands second to Thadi (*Protium Serratum*) which has been used to great extent as a structural timber. In Yamethin Forest Division, the occurrence of Leza is not as high as commercially important species, such as teak (*Tectona grandis*), Pyinkado (*Xylia dolabriformis*), Ingyin (*Pentacme siamensis*), Kanyin (*Dipterocarpus turbinatus*), Thinwin (*Millettia pendula*), and Yemane (*Gmelina arborea*), but among the little-used species, it stands third to Yon (*Anogeisus acuminata*) and Thadi. So it could be observed that out of many lesser known species, Leza occurred in large quantity in the Pegu Yoma Forests, especially in the eastern aspect. With the object of finding out the potential end-uses of the lesser known species of Burma, the physical and mechanical properties of Leza are therefore determined as an exploratory test in the first stage.

The collection of trees for samples is confined to Yamethin Forest Division and the sample size is limited. Hence the strength values presented in this paper would be estimates of species mean values, confined to Yamethin area only. Nevertheless, as the test on Leza has never been carried out in Burma, the data presented in this paper will be of great value in assigning the end use of this species for the wood-using industries. It is intended to carry out a more detail and extensive testing of Leza to obtain the Burma data on the physical and mechanical properties of Leza in future. By exploring the suitability of the previously neglected or little-known species: -

- (1) higher output of timber for domestic and foreign market may be obtained,
- (2) exports of valuable species can be increased, leading to a better earning of foreign exchange for the country,
- (3) harvesting cost per area will be lowered and consumer cost of timber will rise less rapidly and

- (4) species composition of the forest can be improved by removing presently low valued species.

To introduce this lesser known species to the timber Industry and timber user, a note is compiled as a reference in this paper (Appendix V). This note is prepared from some field experience and literatures available.

2. Materials and Methods

As an exploratory test to determine the sample size with required precision for further investigation and to assign the potential end use of Leza with these data, the samples were taken from only three trees of merchantable size (5' gbh and over gbh) collected from Taungnyo Reserved forests in Yamethin Forest Division. Majority of timber was meant for the study of air seasoning behaviors of Leza by the Seasoning and Preservation Section of the Forest Research Institute, Yezin. Few sample pieces were taken for the determination of physical and mechanical properties. Proper selection of wood to get clear straight grain specimens free from knots was carried out.

The samples were planned to the required test sizes for both physical and mechanical tests. The test samples are identified both taxonomically and anatomically.

2.1. Physical Properties

Twelve samples of sizes 1" x 1" x 4" were taken at random from the samples collected for the determination of radial and tangential shrinkage. Eighteen samples of sizes 2" x 2" x 6" were taken for the volumetric shrinkage and specific gravity determination. Water displacement method was used for the volume determination. Number of rings per inch has not been counted as the rings were not conspicuous. So also the percentage of sapwood has not been explored.

Measurements of each specimen were taken nearest to the thousand of an inch and their respective weights were also taken correct to .001 gram.

2.2. Mechanical Properties

The dimensions of specimens for various tests were as shown in table (1) below. Cleavage test and Impact Bending tests were not carried out as proper fitting for the cleavage tests and the machine for the Impact Bending test are not available in the Institute at the moment. The Avery Universal Testing Machine was used for the rest of the tests.

Table (1) Over all dimensions of test specimens for various tests.

| No | Test | Size of specimens |
|----|------------------------------------|-------------------|
| 1. | Static Bending | 2" x 2" x 30" |
| 2. | Compression paralleled to grain | 2" x 2" x 8" |
| 3. | Compression perpendicular to grain | 2" x 2" x 2" |
| 4. | Hardness | 2" x 2" x 6" |
| 5. | Shear | 2" x 2" x 2" |
| 6. | Tension | 2" x 2" x 2½" |

The principal tests made and the properties compiled were: -

- (1) Static Bending test.
 - (i) Fibre stress at Elastic Limit (FS @ EL)
 - (ii) Modulus of Rupture (MR)
 - (iii) Modulus of Elasticity (ME)
 - (iv) Work to Elastic Limit.
- (2) Compression parallel to grain test.
 - (i) Fibre Stress at Elastic Limit (FS @ EL)
 - (ii) Maximum stress
 - (iii) Modulus of Elasticity
- (3) Compression perpendicular to grain test.
 - (i) Fibre stress at Elastic Limit (FS @ EL)
- (4) Hardness test.
 - (i) Radial surface
 - (ii) Tangential surface
 - (iii) End surface
- (5) Shear test.
 - (i) Shear stress-radial
 - (ii) Shear stress-tangential
- (6) Tension perpendicular to grain test.
 - (i) Radial
 - (ii) Tangential

The tests for green condition were made as soon as possible and the tests for dried seasoned condition were done approximately at 12% moisture content. The temperature of testing room could not be maintained to a certain range, but testing were done in a short period to prevent great variation in room temperature.

The moisture content of all test pieces were determined by oven dry method and recorded. The preparation of specimens and the method of test followed the specifications laid down by the American Society for Testing Material as close as possible.

3. Results

3.1. Physical Properties

Results of physical properties as the specific gravity, weight per c. ft, and shrinkage percentages from green to oven dry are given in tables (2) and (3) together with those of In and Kanyin, which gave similar use in timber industry and traded together in combined name as In/Kanyin. The physical properties of teak is also included for the sake of comparison as it is the most famous timber of the country. The properties of Pyinma (*Lagerstroemia speciosa*) which belongs to the same family of Leza is also compared. Pyinkado, one of the strongest timbers and other six species which are similar in strength to Leza are also included.

3.2. Mechanical Properties

Mechanical properties of Leza tested are given in tables (4) and (5). Adjustment of strength values from results of test on dry specimens are corrected to equivalent values at 12% m. c. as described in the "Australian Methods of Mechanically Testing Small Clear Specimens of Timber" by J. J. Mack. The corrected figures are given in tables (6) and (7). The temperature of the testing room

Table (2) Physical Properties of Leza and other species

| Name | | Seasoning | Specific gravity | Moisture Content percent | Weight lb per C.ft | Shrinkage percent | | | Shrinkage ratio Tan/Rad | Adj: Sp.gr. |
|-----------|----------------|-----------|------------------|--------------------------|--------------------|-------------------|------------|--------|-------------------------|-------------|
| Local | Scientific | | | | | Radial | Tangential | Volume | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Leza | Lagerstroemia | Green | 0.522 | 98.2 | 64 | 4.2 | 6.4 | 12.1 | 1.52 | 0.597 |
| | tomentosa | Air Dry | 0.545 | 10.1 | 42 | | | | | |
| In* | Dipterocar pus | Green | 0.726 | 50.3 | 68 | 4.4 | 9.1 | 14.0 | 2.07 | 0.822 |
| | tuberculatus | Air Dry | 0.755 | 19.4 | 56 | | | | | |
| Kanyin* | Dipterocar pus | Green | 0.655 | 65.7 | 68 | 4.2 | 8.9 | 15.0 | 2.12 | 0.732 |
| | turbinatus | Air Dry | 0.689 | 14.3 | 49 | | | | | |
| Teak* | Tectona | Green | 0.586 | 49.4 | 55 | 2.1 | 3.3 | 6.8 | 1.57 | 0.647 |
| | grandis | Air Dry | 0.568 | 14.1 | 40 | | | | | |
| Pyinma* | lagerstroemia | Green | 0.518 | 118.1 | 70 | 4.4 | 6.8 | 12.7 | 1.55 | 0.565 |
| | speciosa | Air Dry | 0.567 | 8.5 | 38 | | | | | |
| Pyinkado* | Xylia | Green | 0.779 | 48.6 | 72 | 3.3 | 6.7 | 11.1 | 2.03 | 0.891 |
| | dolabrifomis | Air Dry | 0.816 | 10.3 | 56 | | | | | |

* Source: - Rodger's A Hand Book of Forest Products of Burma.

Table (3) Physical Properties of Leza and other species

| Name | | Seasoning | Specific gravity | Moisture Content percent | Weight lb per C.ft | Shrinkage percent | | | Shrinkage ratio Tan/Rad | Adj: Sp.gr. |
|----------------|---------------|-----------|------------------|--------------------------|--------------------|-------------------|------------|--------|-------------------------|-------------|
| Local | Scientific | | | | | Radial | Tangential | Volume | | |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| Leza | Lagerstroemia | Green | 0.522 | 98.2 | 64 | 4.2 | 6.4 | 12.1 | 1.52 | 0.597 |
| | tomentosa | Air Dry | 0.545 | 10.1 | 42 | | | | | |
| Binga* | Mitragyna | Green | 0.553 | 58.4 | 55 | 3.8 | 7.3 | 12.0 | 1.92 | 0.607 |
| | rotundifolia | Air Dry | 0.586 | 12.8 | 41 | | | | | |
| Hnaw* | Adina | Green | 583 | 81.4 | 66 | 2.8 | 5.6 | 8.7 | 2.00 | 0.643 |
| | cordifolia | Air Dry | 0.592 | 12.0 | 41 | | | | | |
| Nabe* | Lannea | Green | 0.497 | 94.0 | 60 | 3.0 | 5.4 | 8.4 | 1.80 | 0.540 |
| | grandis | Air Dry | 0.497 | 17.0 | 36 | | | | | |
| Sagawa* | Michelia | Green | 0.426 | 112.9 | 57 | 3.2 | 5.2 | 8.2 | 1.63 | 0.457 |
| | Champaca | Air Dry | 0.441 | 8.8 | 30 | | | | | |
| Taung- thayet* | Swintonia | Green | 0.551 | 58.5 | 54 | 3.2 | 6.0 | 10.8 | 1.88 | 0.605 |
| | floribunda | Air Dry | 0.575 | 13.7 | 41 | | | | | |
| Yemane* | Gmelina | Green | 0.419 | 151.2 | 66 | 2.4 | 4.9 | 8.8 | 2.04 | 0.449 |
| | arborea | Air Dry | 0.432 | 12.1 | 30 | | | | | |

*Source: - Rodger's A Hand Book of Forest Products of Burma.

Table (4) Mechanical Properties of Leza as compared to some other species.

| Name | Seasoning | Moisture content % | STATIC BENDING | | | | Comp: Paral to grain | | Comp: Per: to grain | HARDNESS | | |
|-----------|-----------|--------------------|--------------------|-----------------|-----------------------|-----------------------|----------------------|---------------------|------------------------|-------------------|-----------------|-----------------|
| | | | FS @ EL p. s. i | M. R p. s. i | M. E p. s. i x1000 | Work to EL lb/c.ft | FS @ EL p. s. i | Mix: Cr: p. s. i | FS @ EL p. s. i | Radial lb load | Tan: lb load | End: lb load |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Leza | Green | 98.2 | 6065 | 11005 | 1695 | 1.56 | 4010 | 5115 | 955 | 985 | 990 | 1055 |
| | A D | 12.4 | 9280 | 13265 | 1940 | 2.94 | 4895 | 7145 | 1245 | 1125 | 1076 | 1120 |
| In* | Green | 50.3 | 6990 | 11595 | 1754 | 1.57 | 3670 | 5640 | 1220 | 1420 | 1420 | 1455 |
| | A D | 19.4 | 7205 | 13925 | 1964 | 1.49 | 3540 | 6785 | 900 | 1615 | 1565 | 1575 |
| Kanyin* | Green | 65.7 | 6935 | 11020 | 2020 | 1.35 | 3890 | 5865 | 950 | 1020 | 1010 | 1060 |
| | A D | 14.3 | 8095 | 15605 | 2240 | 1.66 | 3730 | 7745 | 1185 | 1395 | 1285 | 1315 |
| Teak* | Green | 49.4 | 6935 | 11460 | 1640 | 1.65 | 3815 | 5710 | 930 | 980 | 960 | 910 |
| | A D | 14.1 | 9425 | 14465 | 1830 | 2.73 | 5385 | 8350 | 1280 | 960 | 990 | 860 |
| Pyinma* | Green | 118.1 | 5525 | 8590 | 1285 | 1.36 | 3335 | 4275 | 1225 | 1100 | 1085 | 1080 |
| | A D | 8.5 | 6565 | 13255 | 1534 | 1.60 | 5210 | 7250 | 1385 | 1050 | 1060 | 1375 |
| Pyinkado* | Green | 48.6 | 9635 | 15555 | 2265 | 2.43 | 6445 | 8015 | 1700 | 1925 | 1915 | 1825 |
| | A D | 10.3 | 11330 | 20580 | 2530 | 3.02 | 7120 | 11515 | 2210 | 2165 | 2385 | 2080 |

A D = Air dry.

*Source : - A Hand Book of the Forest Products of Burma by Rodger.

Table (4) Mechanical Properties of Leza as compared to some other species. (Cont:)

| Name | Seasoning | SHEAR | | TENSION | |
|-----------|-----------|-----------------|-----------------|-----------------|-----------------|
| | | Rad : p.s.i. | Tan : p.s.i. | Rad : p.s.i. | Tan : p.s.i. |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Leza | Green | 1200 | 1425 | 735 | 850 |
| | A D | 1315 | 1325 | 520 | 795 |
| In* | Green | 1195 | 1345 | 590 | 955 |
| | A D | 1380 | 1600 | 805 | 1075 |
| Kanyin* | Green | 885 | 1055 | 740 | 885 |
| | A D | 1160 | 1345 | 1260 | 880 |
| Teak* | Green | 990 | 1080 | 515 | 685 |
| | A D | 895 | 1390 | 505 | 570 |
| Pyinma* | Green | 1040 | 1195 | 745 | 735 |
| | A D | 1390 | 1685 | 685 | 735 |
| Pyinkado* | Green | 1525 | 1965 | 840 | 1190 |
| | A D | 2130 | 2300 | 485 | 870 |

A D = Air dry.

* Source : - A Hand Book of the Forest Products of Burma by Rodger.

Table (5) Mechanical Properties of Leza as compared to some other species.

| Name | Seasoning | Moisture content % | STATIC BENDING | | | | Comp: Paral to grain | | Comp: Per: to grain | HARDNESS | | |
|-----------|-----------|--------------------|--------------------|-----------------|---------------------|--------------------------|----------------------|-------------------|---------------------|-------------------|-----------------|-----------------|
| | | | FS @ EL p. s. i | M. R p. s. i | M. E p.s.i x1000 | Work to EL lb/c.ft | FS @ EL p.s.i | Mix: Cr: p.s.i | FS @ EL p.s.i | Radial lb load | Tan: lb load | End: lb load |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Leza | Green | 98.2 | 6065 | 11005 | 1695 | 1.56 | 4010 | 5115 | 955 | 985 | 990 | 1055 |
| | A D | 12.4 | 9280 | 13265 | 1940 | 2.94 | 4895 | 7145 | 1245 | 1125 | 1076 | 1120 |
| Binga* | Green | 58.4 | 6425 | 10525 | 1330 | 1.75 | 4030 | 5280 | 990 | 1075 | 1055 | 1230 |
| | A D | 12.8 | 7695 | 14030 | 1603 | 2.11 | 5710 | 7525 | 1345 | 1165 | 1255 | 1580 |
| Hnaw* | Green | 81.4 | 5645 | 9450 | 1215 | 1.50 | 3955 | 4925 | 1085 | 1060 | 1100 | 1255 |
| | A D | 12.2 | 6535 | 11325 | 1362 | 1.76 | 4175 | 6550 | 1475 | 1165 | 1295 | 1440 |
| Nabe* | Green | 94.0 | 3290 | 6065 | 801 | 0.78 | 1935 | 2790 | 555 | 700 | 685 | 740 |
| | A D | 17.0 | 4570 | 8145 | 940 | 1.30 | 2555 | 3805 | 845 | 795 | 770 | 870 |
| Sagawa* | Green | 112.9 | 4795 | 8010 | 1194 | 1.11 | 2985 | 4020 | 630 | 610 | 640 | 640 |
| | A D | 8.8 | 6215 | 9250 | 1387 | 1.58 | 4250 | 6420 | 985 | 760 | 840 | 1005 |
| T'thayet* | Green | 58.5 | 4655 | 8625 | 1638 | 0.77 | 2885 | 4095 | 565 | 750 | 735 | 755 |
| | A D | 13.7 | 6085 | 11435 | 1853 | 1.19 | 3460 | 5590 | 865 | 845 | 860 | 1030 |
| Yemane* | Green | 151.2 | 4060 | 6940 | 1118 | 0.86 | 2410 | 3300 | 680 | 755 | 760 | 670 |
| | A D | 12.1 | 6335 | 9375 | 1287 | 1.74 | 3205 | 4850 | 685 | 490 | 560 | 525 |

A D = Air dry.

*Source : - Rodger's A Hand Book of Forest Products of Burma.

Table (5) Mechanical Properties of Leza as compared to some other species.(Cont:)

| Name | Seasoning | SHEAR | | TENSION | |
|------------|-----------|---------------|-----------------|-----------------|-----------------|
| | | Rad p.s.i. | Tan : p.s.i. | Rad : p.s.i. | Tan : p.s.i. |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Leza | Green | 1200 | 1425 | 735 | 850 |
| | A D | 1315 | 1325 | 520 | 795 |
| Binga * | Green | 1190 | 1300 | 650 | 935 |
| | A D | 1460 | 1445 | 710 | 575 |
| Hnaw * | Green | 1150 | 1300 | 645 | 685 |
| | A D | 1505 | 1490 | 370 | 615 |
| Nabe * | Green | 740 | 905 | 330 | 395 |
| | A D | 955 | 1175 | 565 | 750 |
| Sagawa* | Green | 940 | 1005 | 510 | 545 |
| | A D | 1070 | 1225 | 345 | 380 |
| T'thayet * | Green | 1100 | 1990 | 345 | 595 |
| | A D | 1325 | 1530 | 695 | 885 |
| Yemane * | Green | 890 | 950 | 595 | 650 |
| | A D | 1035 | 1050 | 480 | 415 |

A D = Air Dry.

*Source:- Rodger's A Hand Book of Forest Products of Burma.

Table (6) Mechanical Properties of Leza as compared to some other species. (Air dry values adjusted to 12%+ m. c.)

| Name | Seasoning | Moisture content % | STATIC BENDING | | | | Comp: Paral to grain | | Comp: Per: to grain | HARDNESS | | |
|-----------|-----------|--------------------|--------------------|-----------------|---------------------|--------------------------|----------------------|--------------------|------------------------|-------------------|-----------------|-----------------|
| | | | FS @ EL p. s. i | M. R p. s. i | M. E p.s.i x1000 | Work to EL lb/c.ft | FS @ EL p.s.i | Mix: Cr: p.ss.i | FS @ EL p.s.i | Radial lb load | Tan: lb load | End: lb load |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Leza | Green | 98.2 | 6065 | 11005 | 1695 | 1.56 | 4010 | 5115 | 0 955 | 0 985 | 0 990 | 1055 |
| | A D | 12.0 | 9430 | 13480 | 1950 | 3.30 | 4990 | 7290 | 1270 | 1140 | 1090 | 1140 |
| In* | Green | 50.3 | 6990 | 11595 | 1754 | 1.57 | 3670 | 5640 | 1220 | 1420 | 1420 | 1455 |
| | A D | 12.0 | 9340 | 18050 | 2180 | 2.37 | 4850 | 9295 | 1230 | 1970 | 1910 | 2040 |
| Kanyin* | Green | 65.7 | 6935 | 11020 | 2020 | 1.35 | 3890 | 5865 | 950 | 1020 | 1010 | 1060 |
| | A D | 12.0 | 8840 | 17040 | 2290 | 1.96 | 4168 | 8635 | 1321 | 1491 | 1373 | 1436 |
| Teak* | Green | 49.4 | 6935 | 11460 | 1640 | 1.65 | 3815 | 5710 | 0 930 | 0 080 | 0 960 | 0 910 |
| | A D | 12.0 | 10215 | 15680 | 1885 | 3.18 | 5950 | 9225 | 1414 | 1020 | 1052 | 0 935 |
| Pyinma* | Green | 118.1 | 5525 | 8590 | 1285 | 1.36 | 3335 | 4275 | 1225 | 1100 | 1085 | 1080 |
| | A D | 12.0 | 5645 | 11400 | 1453 | 1.15 | 4298 | 5981 | 1142 | 939 | 948 | 1182 |
| Pyinkado* | Green | 48.6 | 9635 | 15555 | 2265 | 2.43 | 6445 | 8015 | 1700 | 1925 | 1915 | 1825 |
| | A D | 12.0 | 10560 | 19180 | 2465 | 2.61 | 6518 | 10536 | 2022 | 2054 | 2263 | 1938 |

A D = Air dry.

*Source : - A Hand Book of the Forest Products of Burma by Rodger.

Table (6) Mechanical Properties of Leza as compared to some other species. (Continue)
(Air dry values adjusted to 12% m. c.)

| Name | Seasoning | S H E A R | | T E N S I O N | |
|-----------|-----------|-----------------|-----------------|-----------------|-----------------|
| | | Rad : p.s.i. | Tan : p.s.i. | Rad : p.s.i. | Tan : p.s.i. |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Leza | Green | 1200 | 1425 | 735 | 850 |
| | A D | 1330 | 1340 | 523 | 799 |
| In* | Green | 1195 | 1345 | 590 | 955 |
| | A D | 1690 | 1955 | 894 | 1194 |
| Kanyin* | Green | 885 | 1055 | 740 | 885 |
| | A D | 1240 | 1438 | 1289 | 900 |
| Teak* | Green | 990 | 1080 | 515 | 685 |
| | A D | 951 | 1477 | 522 | 587 |
| Pyinma* | Green | 1040 | 1195 | 745 | 735 |
| | A D | 1244 | 1508 | 649 | 696 |
| Pyinkado* | Green | 1525 | 1965 | 840 | 1190 |
| | A D | 2021 | 2201 | 472 | 847 |

A D = Air dry.

* Source : - A Hand Book of the Forest Products of Burma by Rodger.

**Table (7) Mechanical Properties of Leza as compared to some other species.
(Air dry values adjusted to 12% m. c.)**

| Name | Seasoning | Moisture content % | STATIC BENDING | | | | Comp: Paral to grain | | Comp: Per: to grain | HARDNESS | | |
|-----------|-----------|--------------------|-----------------|--------------|------------------|--------------------|----------------------|----------------|---------------------|----------------|--------------|--------------|
| | | | FS @ EL p. s. i | M. R p. s. i | M. E p.s.i x1000 | Work to EL lb/c.ft | FS @ EL p.s.i | Mix: Cr: p.s.i | FS @ EL p.s.i | Radial lb load | Tan: lb load | End: lb load |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) |
| Leza | Green | 98.2 | 6065 | 11005 | 1695 | 1.56 | 4010 | 5115 | 955 | 985 | 990 | 1055 |
| | A D | 12 | 9430 | 13480 | 1950 | 3.03 | 4990 | 7290 | 1270 | 1140 | 1090 | 1140 |
| Binga* | Green | 58.4 | 6425 | 10525 | 1330 | 1.75 | 4030 | 5280 | 990 | 1075 | 1055 | 1230 |
| | A D | 12 | 7941 | 14478 | 1622 | 2.24 | 5938 | 7826 | 1398 | 1193 | 1285 | 1630 |
| Hnaw* | Green | 81.4 | 5645 | 9450 | 1215 | 1.50 | 3955 | 4925 | 1085 | 1060 | 1100 | 1255 |
| | A D | 12 | 6545 | 11343 | 1366 | 1.79 | 4216 | 6615 | 1489 | 1172 | 1303 | 1442 |
| Nabe* | Green | 94.0 | 3290 | 6065 | 801 | 0.78 | 1935 | 2790 | 555 | 700 | 685 | 740 |
| | A D | 12 | 5484 | 9774 | 1010 | 1.82 | 3193 | 4756 | 1056 | 914 | 885 | 1044 |
| Sagawa* | Green | 112.9 | 4795 | 8010 | 1194 | 1.11 | 2985 | 4020 | 630 | 610 | 640 | 640 |
| | A D | 12 | 5419 | 8066 | 1320 | 1.17 | 3570 | 5392 | 827 | 687 | 795 | 876 |
| T'thayet* | Green | 58.5 | 4655 | 8625 | 1638 | 0.77 | 2885 | 4995 | 565 | 750 | 735 | 755 |
| | A D | 12 | 6498 | 12212 | 1900 | 1.35 | 3754 | 6065 | 938 | 888 | 903 | 1100 |
| Yemane* | Green | 151.2 | 4060 | 6940 | 1118 | 0.86 | 2410 | 3300 | 680 | 755 | 760 | 670 |
| | A D | 12 | 6360 | 9412 | 1289 | 1.75 | 3221 | 4874 | 688 | 491 | 562 | 527 |

A D = Air Dry

* Source :- Rodger's A Hand Book of Forest Products of Burma.

Table (7) Mechanical Properties of Leza as compared to some other species.(Continue)
(Air dry values adjusted to 12% m. c)

| Name | Seasoning | S H E A R | | T E N S I O N | |
|------------|-----------|-----------------|-----------------|-----------------|-----------------|
| | | Rad : p.s.i. | Tan : p.s.i. | Rad : p.s.i. | Tan : p.s.i. |
| (1) | (2) | (3) | (4) | (5) | (6) |
| Leza | Green | 1200 | 1425 | 735 | 850 |
| | A D | 1330 | 1340 | 523 | 799 |
| Binga * | Green | 1190 | 1300 | 650 | 935 |
| | A D | 1495 | 1479 | 755 | 612 |
| Hnaw * | Green | 1150 | 1320 | 645 | 685 |
| | A D | 1514 | 1499 | 371 | 617 |
| Nabe * | Green | 740 | 905 | 330 | 395 |
| | A D | 1098 | 1351 | 607 | 806 |
| Sagawa* | Green | 940 | 1005 | 510 | 545 |
| | A D | 967 | 1107 | 328 | 362 |
| T'thayet * | Green | 1100 | 1290 | 345 | 595 |
| | A D | 1392 | 1608 | 712 | 907 |
| Yemane * | Green | 890 | 950 | 595 | 650 |
| | A D | 1038 | 1053 | 481 | 416 |

A D = Air Dry.

*Source:- Rodger's A Hand Book of Forest Products of Burma.

could not be maintained to the standard degree and so the strength values of the tests were corrected to appropriate values as mentioned in the above Australian practice. Mean values of properties of Leza tested green and dry are compared in tables (4) (5) (6) and (7) with teak, In and Kanyin. It is also compared with the properties of Pyinkado, as it is one of the strongest timbers in Burma. Some other species as Pyinma, Binga (*Mitragyna roundifolia*), Hnaw (*Adina cordifolia*), Nabe (*Lannea grandis*), Sagawa (*Michelia champaca*), Taungthayet (*Swintonia floribunda*) and Yemane are also included for comparison. In tables (8) and (9), the index of suitability for different utility is given, teak taken as cent per cent suitable in every respect. It is to be mentioned that this tables compared the combined strength values of different species by adjustment and applying weighting factors, rather than comparing directly the individual values (Limaye and Seaman). It could be seen in the table that the index shows the suitability as a beam, post and so on. This table is prepared in order to make the result of testing more applicable by the timber producer and timber user. It provides an easy comparison between Leza and other species and it transforms the technical data into a simple form of quick reference to non-technical people.

4. Discussion

Leza is a light timber with a density of 421b/c. ft. and a specific gravity of .54. Its dry weight is comparable to teak and Pyinma, denser than Binga, Hnaw, Nabe, Sagawa, Taungthayet and Yemane, but a little lighter than In/Kanyin and much lighter than Pyinkado. Specific gravity of Leza has the same trend. Specific gravities adjusted to volume at 12% m. c. showed that, apart from Pyinkado, In, Kanyin, and Hnaw, the specific gravity of leza is not significantly different from other species. Density and specific gravity are the simple index to the end use of a species and hence, Leza could be put into the similar end uses of Pyinma, Binga, Nabe, Sagawa and Yemane.

The magnitude of shrinkage of Leza is similar to Pyinma and Pyinkado, and more stable than In/Kanyin. Compare to other species like Hnaw, Nabe, Sagawa and Yemane, Leza is considerable higher in shrinkage. On the other hand, Leza has a lesser shrinkage ratio. It therefore could be used like In/Kanyin, especially as construction timber for light resident buildings.

Regarding strength, Leza has a considerable strength and stiffness. This property is a fundamental requisite for beams, joints and flooring. Table (9) showed that Leza has strength as a beam as nearly strong as In/Kanyin; but superior than those of Pyinma, Binga, Hnaw, Nabe, Sagawa, Taungthayet, and Yemane. This is true also for stiffness as a beam. Therefore from this table, Leza tends to show that it could be put into use as beams, joints and flooring like In/Kayin. With such stiffness, there is a possibility of using Leza as oars/also.

As a post, the figure of leza (table 9) indicated that it is as nearly strong as In/Kayin, but inferior to Pyinkado, and superior to other species such as Pyinma, Binga, Hnaw, Nabe, Sagawa and Yemane. It is therefore possible to use Leza as posts in second class buildings and in light framing. It will be also good for short posts and columns.

Retention of shape is similar to Pyinkado, Binga, and Taungthayet. It is more stable than In/Kayin and Pyinma. Hnaw, Nabe, Sagawa and Yemane are superior to

Table (8) Combined Calculated Suitability Index of Some Burmese species.

| Species Strength | Teak | Leza | In | Kanyin | Pyinma | Pyinkado | Binga | Hnaw | Nabe | Sagawa | Thayet | Yemane |
|-------------------------|-------------|-------------|-----------|---------------|---------------|-----------------|--------------|-------------|-------------|---------------|---------------|---------------|
| Sterngth as a beam | 12745 | 11628 | 13221 | 12638 | 9268 | 16382 | 11516 | 9830 | 6958 | 7960 | 9295 | 7679 |
| Stiffness as a beam | 1721 | 1780 | 1896 | 2110 | 1341 | 2331 | 1427 | 1265 | 870 | 1236 | 1725 | 1175 |
| Suitability as a post | 6714 | 6347 | 6717 | 6914 | 5117 | 9086 | 6155 | 5418 | 3412 | 4626 | 5354 | 4092 |
| Rention of shape | 14.72 | 10.31 | 8.44 | 8.27 | 9.86 | 10.35 | 10.23 | 12.9 | 12.54 | 13.00 | 10.96 | 12.54 |
| Shear | 1122 | 1239 | 1173 | 1022 | 1125 | 1745 | 1245 | 1244 | 892 | 933 | 1213 | 903 |
| Hardnees | 1105 | 1150 | 1622 | 1247 | 1213 | 2007 | 1182 | 1215 | 842 | 752 | 849 | 721 |

Table (9) Relative Suitability of Leza and other selected species as percentage of strength of teak (Teak = 100 in every property)

| Species Strength | Teak | Leza | In | Kanyin | Pyinma | Pyinkado | Binga | Hnaw | Nabe | Sagawa | T'thayet | Yemane |
|-------------------------|-------------|-------------|-----------|---------------|---------------|-----------------|--------------|-------------|-------------|---------------|-----------------|---------------|
| Sterngth as a beam | 100 | 91 | 104 | 99 | 73 | 128 | 90 | 77 | 55 | 62 | 73 | 60 |
| Stiffness as a beam | 100 | 103 | 110 | 122 | 78 | 135 | 83 | 74 | 51 | 72 | 100 | 68 |
| Suitability as a post | 100 | 95 | 100 | 102 | 76 | 135 | 92 | 81 | 51 | 69 | 80 | 61 |
| Rention of shape | 100 | 70 | 57 | 56 | 67 | 70 | 69 | 88 | 85 | 88 | 74 | 85 |
| Shear | 100 | 110 | 105 | 91 | 100 | 155 | 111 | 111 | 76 | 83 | 108 | 80 |
| Hardnees | 100 | 104 | 147 | 112 | 110 | 187 | 107 | 110 | 76 | 68 | 77 | 65 |

Leza in this respect. As mentioned above, Leza with such retention could be used in rough furniture, work as has been used with In/Kayin.

In hardness, Leza is as hard as teak, harder than Nabe, Sagawa, Taungthayet, and Yemane. Compared to In/Kayin, Pyinkado, Binga and Hnaw, it is softer. Hardness is essential for flooring and mallets. Leza being as hard as teak, it is good for flooring and with less stability, it could be expected to be good for flooring in second class constructions.

Shear strength is essential in beams, especially short heavily loaded ones and of bolted timber. Shear strength is an important design criterion for nearly all timber structures. Leza, Binga, Hnaw and Taungthayet have higher shear strength, but Pyinkado has the highest. Nabe, Sagawa and Yemane are inferior. So Leza is possible to be used as beams, bolted timbers and rollers.

5. Conclusions

Leza, with regard to the physical and mechanical property, could be used as a construction timber. It is good for used as beams, joint, flooring, walling, wall framing, paving blocks, posts and columns. It is also usable for making rough furniture, mallets, and rollers. It is good for use as bolted timber. Light framing and window frame are the places where Leza could be used. Leza on the other hand has considerable movement and durability (appendix V) and hence it is suggested that it should be used after being properly seasoned and preservative treated. Considerable movement also leads to the use of Leza only in second class building like bungalow and resident quarters. It is advisable to use without treatment only for indoor works such as partition walls, flooring, wall framing and window frames.

Leza, in term of strength is definitely inferior to teak and Pyinkado; and as nearly strong as In and Kanyin. It is equally good as Pynma, Binga, and Hnaw and stronger than Nabe, Sagawa, Taungthayet and Yemane. Therefore durability being the same, Leza could be used in place of Hnaw, Pynma, Binga, Nabe, Sagawa, Taungthayet and Yemane. With proper seasoning and treatment, Leza could be substituted in places of In and Kanyin.

It is advisable to accelerate the mode of transportation, storage and cutting of these lesser-known species, which are normally non-durable so as to save wastage and lost. A systematic storage or piling of sawn timber should also be enforced in the milling sites to reduce degradation by natural agencies.

Consideration for the exploration of potential end use of Leza in this paper has been given, based on the strength properties only. Although strength qualities is an essential requisite to find out the potential end uses of a species, other properties such as seasoning properties, workability properties, durability, appearance, and chemical properties should also be studied. The writer, with the object of exploring the potential end uses of little-used species of Burma, intended to work further with the cooperation of other sections of the Forest Products Research Division of the Forest Research Institute, Yezin, in pace with further availability of equipment, man power and other facilities in near future. It is strongly believed that this type of work will provide technical information on the potential end uses of a species from, different angles of wood technology rather than from the physical and mechanical properties only.

Botanical Names of Some Tree Species

| Sr. No. | Burmese Name. | Botanical Name. |
|----------------|----------------------|----------------------------------|
| 1. | Binga | <i>Mitragyna rotundifolia</i> |
| 2. | Hnaw | <i>Adina cordifolia</i> |
| 3. | In | <i>Dipterocarpus tuberculata</i> |
| 4. | Kanyin | <i>Dipterocarpus turbinatus</i> |
| 5. | Leza | <i>Lagerstroemia tomentosa</i> |
| 6. | Nabe | <i>Lanea grandis</i> |
| 7. | Pyinma | <i>Lagerstroemia speciosa</i> |
| 8. | Pyinkado | <i>Xylia dolabriformis</i> |
| 9. | Sagawa | <i>Michelia champaca</i> |
| 10. | Taungthayet | <i>Swintonia floribunda</i> |
| 11. | Teak | <i>Tectona grandis</i> |
| 12. | Yemane | <i>Gmelina arborea</i> |
| 13. | Thadi | <i>Protium serratum</i> |
| 14. | Ingyin | <i>Pentacme siamensis</i> |
| 15. | Thinwin | <i>Millettia pendula</i> |
| 16. | Yon | <i>Anogeisus acuminata</i> |

References

1. A.S.T.M – Standard Methods of Testing Small Clear Specimens of Timber. D143- 27.
2. Boliden _ Informations on the Boliden Impregnation Plant.
3. British standard Institution - Method of Testing Small Clear specimens of Timber.
4. Brown, Panshin, and Forsaith- Textbook of wood Technology Vol. II.
5. F.A.O. – Standard Nomenclature of the Exportable Timers of The Asia – Pacific Region.
6. Forest Department, Burma- Forest Inventory Survey Reports.
7. Limaye and Seaman- Suitability and selection of Timbers for different Uses. Indian Forest Records vol. 3. No.5.
8. Mack J. J – Australian Methods for Mechanically Testing Small Clear Specimens of Timber.
9. Pearson R.S. and Brown H. P- Commercial Timbers of India.
10. Rodger A. A Handbook of the Forest Products of Burma.
11. Wagaard F.F-The Mechanical Properties of Wood.

Growing Stock 4' and over gbh in some forest divisions

| Species | Area in acres | Teak | Pyinkado | Binga | Chinyoke | Hnaw | In | Ingyin | Kanyin | kuthan |
|----------------------|---------------|---------|----------|--------|----------|--------|---------|--------|---------|--------|
| Division | | | | | | | | | | |
| N-Toungoo (1964-65) | 535779 | 371656 | 710153 | 39246 | - | 4458 | 431373 | 58484 | 150315 | 8157 |
| Pyinmana (1965-66) | 432322 | 661995 | 830786 | 71129 | - | 13395 | 46854 | 79582 | 35269 | 29633 |
| Yamethin (1966-67) | 208354 | 1106369 | 434323 | 36248 | 67420 | 41437 | 39287 | 167898 | 3044607 | 44994 |
| Mandalay (1967-68) | 292198 | 333260 | 989923 | 118362 | 31377 | 27910 | 1763908 | 362268 | 33400 | 11475 |
| E-Katha (1968-69) | 235131 | 190922 | 8515 | 4963 | 7933 | 16481 | 2642049 | 174078 | 32407 | 1449 |
| U-Chindwin (1969-70) | 239081 | 328304 | 254507 | 9066 | 30004 | 812 | 81626 | 101559 | 740271 | 90115 |
| Shwebo (1970-71) | 285160 | 42463 | 48194 | 2859 | 6439 | 5776 | 1091000 | 64225 | - | 798 |
| W-Katha (1971-72) | 64488 | 241917 | - | 1283 | 9545 | 2679 | 218021 | 42645 | 28905 | 1177 |
| U-Chinawin (1971-72) | 190579 | 11677 | 33395 | 1460 | 2783 | 1882 | 1383481 | 62935 | 122727 | 160 |
| Shwebo (1972-73) | 313988 | 391425 | 362379 | 29020 | 70259 | 104311 | 174603 | 360590 | 76 | 63102 |
| Prome (1974-75) | 585217 | 962519 | 1247982 | 161012 | 166017 | 342226 | 58503 | 152196 | 6292 | 33885 |

*Source : - Forest Department Inventory Survey.

Appendix I

Growing Stock 4' and over gbh in some forest divisions

| Species Division | Leza | Ma-U | Nabe | Padauk | Panga | Pyinma | Sagawa | Sit | Tamalan | Taukkyan |
|-------------------------|--------|-------|--------|--------|--------|--------|--------|--------|---------|----------|
| N-Toungoo (1964-65) | 379986 | - | - | 31227 | 67853 | 10997 | 21063 | 39683 | 348 | 63299 |
| Pyinmana (1965-66) | 223646 | - | - | 47710 | 36790 | 11738 | 44 | 48410 | 4872 | 88517 |
| Yemathin (1966-67) | 130131 | - | 113225 | 87454 | 26664 | 5103 | - | 4714 | 11608 | 54562 |
| Mandalay (1967-68) | 49971 | - | 67723 | 79658 | 53605 | 37253 | 357 | 606121 | 23772 | 272377 |
| E-Katha (1968-69) | 4875 | - | 17213 | 15341 | 15660 | 2035 | 112 | 122 | 33430 | 113214 |
| U-Chindwin (1969-70) | 7094 | - | 38746 | - | 8395 | 11766 | 12150 | 957 | 43092 | 181330 |
| Shwebo (1970-71) | 4485 | - | 8141 | 2655 | 7895 | 497 | - | 2895 | 5195 | 62495 |
| W-Katha (1971-72) | 5882 | - | 13362 | - | 14992 | 3242 | - | 478 | 18966 | 66502 |
| U-Chinawin (1971-72) | 2094 | - | 3977 | 6638 | 11399 | 404 | - | 58 | 7248 | 14799 |
| Shwebo (1972-73) | 14465 | - | 58353 | 227632 | 53706 | 6017 | - | 2483 | 20411 | 85479 |
| Prome (1974-75) | 119250 | 27468 | 311927 | 14309 | 149499 | 25861 | 9042 | 20272 | 3458 | 2430763 |

*Source : - Forest Department Inventory Survey.

Growing Stock 4' and over gbh in some forest divisions

| Species Division | Thabye | Thadi | Thinwin | Thit-kado | Thitya | Yamane | Yindaik | Yinma | Yon | Zinbyun |
|-------------------------|--------|--------|---------|-----------|---------|---------|---------|-------|--------|---------|
| N-Toungoo (1964-65) | 69990 | 198423 | 28337 | 10397 | 83005 | 19489 | - | 7325 | 141235 | 35403 |
| Pyinmana (1965-66) | 46795 | 330263 | 99224 | 714 | 35225 | 33718 | - | 20386 | 172983 | 43002 |
| Yamethin (1966-67) | 6279 | 146047 | 679399 | 44 | 41157 | 1306375 | 32589 | 27786 | 146427 | 8095 |
| Mandalay (1967-68) | 23015 | 96527 | 72101 | 1482 | 247090 | 14656 | 44003 | 21684 | 44034 | 74265 |
| E-Katha (1968-69) | 21558 | 48480 | 2520 | - | 61482 | 1077 | 11032 | 1243 | 3940 | 22567 |
| U-Chindwin (1969-70) | 56410 | 114363 | 17309 | - | 21989 | 21310 | 1870 | 4691 | 6054 | 57378 |
| Shwebo (1970-71) | 15378 | 5651 | 7277 | - | 136399 | 1729 | 2078 | 2615 | 2158 | 4557 |
| W-Katha (1971-72) | 20101 | 38007 | 198 | 36 | 224 | 5942 | 53 | 1119 | 2600 | 33143 |
| U-Chinawin (1971-72) | 31288 | 19387 | 5455 | 126 | 157356 | 2329 | 239 | 729 | 1089 | 1980 |
| Shwebo (1972-73) | 14127 | 46234 | 146726 | 320 | 63544 | 15211 | 16347 | 13907 | 105194 | 29067 |
| Prome (1974-75) | 25044 | 97627 | 170720 | 321 | 1088050 | 17219 | 155165 | 20647 | 202134 | 466275 |

*Source : - Forest Department Inventory Survey.

Stock per acre 4' and over gbh in some forest division

| Species | Teak | Pyinkado | Binga | Chinyoke | Hnaw | In | Ingyin | Kanyin | Kuthan | Leza | Ma-U |
|----------------------|------|----------|-------|----------|------|-------|--------|--------|--------|------|------|
| Division | | | | | | | | | | | |
| N-Toungoo (1964-65) | 0.69 | 1.33 | 0.07 | - | 0.01 | 0.81 | 0.11 | 0.28 | 0.02 | 0.71 | - |
| Pyinmana (1965-66) | 1.53 | 1.92 | 0.16 | - | 0.03 | 0.11 | 0.18 | 0.08 | 0.07 | 0.52 | - |
| Yamethin (1966-67) | 5.31 | 2.08 | 0.17 | 0.32 | 0.20 | 0.19 | 0.81 | 14.61 | 0.22 | 0.62 | - |
| Mandalay (1967-68) | 1.14 | 3.39 | 0.41 | 0.11 | 0.10 | 6.04 | 1.24 | 0.11 | 0.04 | 0.17 | - |
| E-katha (1968-69) | 0.81 | 0.04 | 0.02 | 0.03 | 0.07 | 11.24 | 0.74 | 0.14 | 0.01 | 0.02 | - |
| U-Chindwin (1969-70) | 1.37 | 1.06 | 0.04 | 0.13 | - | 0.34 | 0.42 | 3.10 | 3.77 | 0.03 | - |
| Shwebo (1970-71) | 0.15 | 0.17 | 0.01 | 0.02 | 0.02 | 3.83 | 0.23 | - | - | 0.02 | - |
| W-katha (1971-72) | 3.75 | - | 0.02 | 0.15 | 0.04 | 3.38 | 0.66 | 0.45 | 0.02 | 0.09 | - |
| U-Chindwin (1971-72) | 0.06 | 0.18 | 0.01 | 0.01 | 0.01 | 7.26 | 0.33 | 0.64 | - | 0.01 | - |
| Shwebo (1972-73) | 1.25 | 1.15 | 0.09 | 0.22 | 0.33 | 0.56 | 1.15 | - | 0.20 | 0.05 | - |
| Prome (1974-75) | 1.64 | 2.13 | 0.28 | 0.28 | 0.58 | 0.10 | 0.26 | 0.01 | 0.06 | 0.20 | 0.05 |

* Source: - Forest Department Inventory Survey

Appendix II

Stock per acre 4' and over gbh in some forest divisions

| Species Division | Nabe | Padauk | Panga | Pyinma | Sagawa | Sit | Tamalan | Taukkyan | Thabye | Thadr | Thinwin |
|-----------------------------|-------------|---------------|--------------|---------------|---------------|------------|----------------|-----------------|---------------|--------------|----------------|
| N-Toungoo (1964-65) | - | 0.06 | 0.13 | 0.02 | 0.04 | 0.07 | - | 0.12 | 0.13 | 0.37 | 0.05 |
| Pyinmana (1965-66) | - | 0.11 | 0.09 | 0.03 | - | 0.11 | 0.01 | 0.20 | 0.11 | 0.76 | 0.23 |
| Yamethin (1966-67) | 0.54 | 0.42 | 0.13 | 0.02 | - | 0.02 | 0.06 | 0.26 | 0.03 | 0.70 | 3.26 |
| Mandalay (1967-68) | 0.23 | 0.27 | 0.18 | 0.13 | - | 2.07 | 0.08 | 0.93 | 0.08 | 0.33 | 0.25 |
| E-katha (1968-69) | 0.07 | 0.07 | 0.07 | 0.01 | - | - | 0.14 | 0.48 | 0.09 | 0.21 | 0.01 |
| U-Chindwin (1969-70) | 0.16 | - | 0.04 | 0.05 | 0.05 | - | 0.18 | 0.76 | 0.24 | 0.48 | 0.07 |
| Shwebo (1970-71) | 0.03 | 0.01 | 0.03 | - | - | 0.01 | 0.02 | 0.22 | 0.05 | 0.02 | 0.03 |
| W-katha (1971-72) | 0.21 | - | 0.23 | 0.05 | - | - | 0.29 | 1.03 | 0.31 | 0.59 | - |
| U-Chindwin (1971-72) | 0.02 | 0.03 | 0.06 | - | - | - | 0.04 | 0.08 | 0.16 | 0.10 | 0.03 |
| Shwebo (1972-73) | 0.19 | 0.72 | 0.17 | 0.02 | - | 0.01 | 0.07 | 0.27 | 0.04 | 0.15 | 0.47 |
| Prome (1974-75) | 0.53 | 0.02 | 0.26 | 0.04 | 0.02 | 0.03 | 0.01 | 4.15 | 0.04 | 0.17 | 0.29 |

* Source:- Forest Department Inventory Survey

Stock per acre 4 and over gbh in some forest division

| Species | Thitkado | Thitya | Yamane | Yindaik | Yinma | Yon | Zinbyun |
|----------------------|----------|--------|--------|---------|-------|------|---------|
| N-Taungoo (1964-65) | 0.02 | 0.15 | 0.04 | - | 0.01 | 0.26 | 0.07 |
| Pyinmana (1965-66) | - | 0.08 | 0.08 | - | 0.05 | 0.40 | 0.10 |
| Yamethin (1966-67) | - | 0.20 | 6.27 | 0.16 | 0.13 | 0.70 | 0.04 |
| Mandalay (1967-68) | 0.01 | 0.85 | 0.05 | 0.15 | 0.07 | 0.15 | 0.25 |
| E-Katha (1968-69) | - | 0.26 | - | 0.05 | 0.01 | 0.02 | 0.10 |
| U-Chindwin (1969-70) | - | 0.09 | 0.09 | 0.01 | 0.02 | 0.03 | 0.24 |
| Shwebo (1970-71) | - | 0.48 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| W-Katha (1971-72) | - | - | 0.93 | - | 0.02 | 0.04 | 0.51 |
| U-Chindwin (1971-72) | - | 0.83 | 0.01 | - | - | 0.01 | 0.01 |
| Shwebo (1972-73) | - | 0.20 | 0.05 | 0.05 | 0.04 | 0.34 | 0.09 |
| Prome (74-75) | - | 1.86 | 0.03 | 0.27 | 0.04 | 0.35 | 0.08 |

*Source : - Forest Department Inventory survey.

Growing Stock 2' and over gbh in some forest divisions

| Species Division | Area in acres | Teak | Pyinkado | Binga | Chinyoke | Hnaw | In | Ingyin | Kanyin | Kuthan |
|-------------------------|------------------|---------|----------|---------|----------|--------|---------|---------|---------|--------|
| N-Toungoo (1964-65) | 535779 | 899561 | 1502649 | 261427 | - | 10030 | 1492764 | 193752 | 243797 | 26545 |
| Pyinmana (1965-66) | 432322 | 1358229 | 1701215 | 341969 | - | 25865 | 164216 | 174791 | 49032 | 69212 |
| Yamethin (1966-67) | 208354 | 1395723 | 647314 | 201253 | 120103 | 95206 | 148794 | 392757 | 3754538 | 125606 |
| Mandalay (1967-68) | 292198 | 570981 | 1375294 | 190575 | 60231 | 70991 | 3355100 | 1125863 | 55270 | 25510 |
| E-Katha (1968-69) | 235131 | 611167 | 15423 | 44699 | 24762 | 32413 | 6546109 | 446727 | 53766 | 4620 |
| U-Chindwin (1969-70) | 239081 | 564923 | 387528 | 54708 | 76520 | 2971 | 199535 | 213359 | 1270006 | 904401 |
| Shwebo (1970-71) | 285160 | 98392 | 153600 | 28876 | 22057 | 22796 | 4885503 | 483959 | 142 | 8101 |
| W-Katha (1971-72) | 64488 | 563923 | - | 77979 | 27470 | 6234 | 482507 | 109225 | 55086 | 4962 |
| U-Chindwin (1971-72) | 190579 | 27413 | 196218 | 12869 | 25608 | 6636 | 3492760 | 202575 | 228234 | 1333 |
| Shwebo (1972-73) | 313988 | 676052 | 672846 | 185299 | 154851 | 186849 | 863068 | 1444006 | 228 | 172475 |
| Prome (1974-75) | 585217 | 1578039 | 2216844 | 1017901 | 362944 | 415569 | 167916 | 334220 | 6768 | 92415 |

*Source : - Forest Department Inventory Survey.

Appendix III

Growing Stock 2' and over gbh in some forest divisions

| Species Division | Leza | Ma-U | Nabe | Padauk | Panga | Pyinma | Sagawa | Sit | Tamalan | Taukkyan |
|-------------------------|--------|-------|--------|--------|--------|--------|--------|--------|---------|----------|
| N-Toungoo (1964-65) | 662444 | - | - | 72129 | 219517 | 40727 | 48460 | 101709 | 1043 | 208054 |
| Pyinmana (1965-66) | 578280 | - | - | 93848 | 106644 | 49372 | 154 | 235162 | 16283 | 162909 |
| Yamethin (1966-67) | 267684 | - | 184777 | 137144 | 88723 | 629762 | - | 9169 | 33647 | 118847 |
| Mandalay (1967-68) | 160733 | - | 140814 | 142577 | 130747 | 85791 | 703 | 625239 | 93664 | 663712 |
| E-Katha (1968-69) | 33302 | - | 54647 | 29467 | 104266 | 3825 | 224 | 122 | 277878 | 383554 |
| U-Chindwin (1969-70) | 23845 | - | 75952 | - | 66453 | 24944 | 27304 | 1639 | 155130 | 351460 |
| Shwebo (1970-71) | 21032 | - | 24491 | 7877 | 162636 | 2203 | - | 9514 | 46324 | 419510 |
| W-Katha (1971-72) | 14199 | - | 32358 | - | 46563 | 14653 | - | 478 | 99630 | 137802 |
| U-Chindwin (1971-72) | 9637 | - | 36387 | 12770 | 115212 | 1465 | 288 | 927 | 61148 | 74447 |
| Shwebo (1972-73) | 66353 | - | 105610 | 373154 | 161122 | 13771 | - | 10980 | 90929 | 271640 |
| Prome (1974-75) | 339008 | 42446 | 575881 | 20528 | 390651 | 178365 | 9953 | 65258 | 6712 | 3727224 |

*Source : - Forest Department Inventory Survey.

Appendix III

Growing Stock 2' and over gbh in some forest divisions*

| Species Division | Thabye | Thadi | Thinwin | Thit-kado | Thitya | Yamane | Yindaik | Yinma | Yon | Zinbyun |
|-----------------------------|---------------|--------------|----------------|------------------|---------------|---------------|----------------|--------------|------------|----------------|
| N-Toungoo (1964-65) | 220049 | 387019 | 78269 | 22309 | 331863 | 45558 | - | 17801 | 276493 | 121044 |
| Pyinmana (1965-66) | 183142 | 646689 | 352227 | 13123 | 95246 | 71582 | - | 46587 | 355293 | 116588 |
| Yamethin (1966-67) | 13202 | 229613 | 775599 | 16481 | 111425 | 1310188 | 71148 | 55149 | 246577 | 27453 |
| Mandalay (1967-68) | 92026 | 224320 | 227000 | 504017 | 971888 | 24840 | 150605 | 39508 | 86658 | 161725 |
| E-Katha (1968-69) | 113240 | 135136 | 9169 | 1401 | 197240 | 2260 | 56946 | 4073 | 8487 | 194154 |
| U-Chindwin (1969-70) | 190934 | 262672 | 64538 | 17375 | 38408 | 34013 | 5142 | 9361 | 15162 | 129912 |
| Shwebo (1970-71) | 231777 | 17667 | 26636 | - | 1062972 | 3386 | 11435 | 6894 | 5019 | 43336 |
| W-Katha (1971-72) | 102084 | 120919 | 2153 | 314 | 350 | 8899 | 133 | 2225 | 4481 | 92731 |
| U-Chindwin (1971-72) | 277968 | 78065 | 22594 | - | 560944 | 4889 | 908 | 2109 | 2428 | 43846 |
| Shwebo (1972-73) | 52650 | 127800 | 986031 | 2458 | 482754 | 27893 | 71061 | 31721 | 225067 | 51499 |
| Prome (1974-75) | 35591 | 154583 | 605761 | 3524 | 1373606 | 26058 | 544080 | 36397 | 444271 | 720521 |

*Source : - Forest Department Inventory Survey.

Growing Stock per acre 2' and over gbh in some forest divisions*

| Species Division | Teak | pyinkado | Binga | Chinyoke | Hnaw | In | Ingyin | Kanyin | Kuthan | Leza |
|-------------------------|------|----------|-------|----------|------|-------|--------|--------|--------|------|
| N-Toungoo (1964-65) | 1.68 | 2.80 | 0.49 | - | 0.02 | 2.79 | 0.36 | 0.45 | 0.05 | 1.24 |
| Pyinmana (1965-66) | 3.14 | 3.93 | 0.79 | - | 0.06 | 0.38 | 0.40 | 0.11 | 0.16 | 1.34 |
| Yamethin (1966-67) | 6.70 | 3.11 | 0.96 | 0.58 | 0.46 | 0.71 | 1.88 | 18.02 | 0.60 | 1.28 |
| Mandalay (1967-68) | 1.95 | 4.71 | 0.65 | 0.21 | 0.24 | 11.48 | 3.85 | 0.19 | 0.09 | 0.55 |
| E-Katha (1968-69) | 2.60 | 0.06 | 0.19 | 0.10 | 0.14 | 27.84 | 1.90 | 0.23 | 0.02 | 0.14 |
| U-Chindwin (1969-70) | 2.36 | 1.62 | 0.23 | 0.32 | 0.01 | 0.83 | 0.89 | 5.31 | 3.78 | 0.10 |
| Shwebo (1970-71) | 0.35 | 0.53 | 0.10 | 0.08 | 0.08 | 17.13 | 1.70 | - | 0.03 | 0.07 |
| W-Katha (1971-72) | 8.74 | - | 1.21 | 0.43 | 0.10 | 7.48 | 1.69 | 0.85 | 0.08 | 0.22 |
| U-Chindwin (1971-72) | 0.14 | 1.03 | 0.07 | 0.13 | 0.03 | 18.33 | 1.06 | 1.20 | 0.01 | 0.05 |
| Shwebo (1972-73) | 2.15 | 2.14 | 0.59 | 0.49 | 0.59 | 2.75 | 4.60 | - | 0.55 | 0.21 |
| Prome (1974-75) | 2.69 | 3.79 | 1.74 | 0.62 | 0.71 | 0.29 | 0.57 | 0.01 | 0.16 | 0.58 |

*Source : - Forest Department Inventory Survey.

Appendix IV

Stock per acre 2' and over gbh in some forest divisions

| species Division | Ma-U | Nabe | Padauk | Panga | Pyinma | Sagawa | Sit | Tamalan | Taukkyan | Thabye | Thadi |
|-------------------------|------|------|--------|-------|--------|--------|------|---------|----------|--------|-------|
| N-Toungoo (1964-65) | - | - | 0.13 | 0.41 | 0.08 | 0.09 | 0.19 | - | 0.39 | 0.41 | 0.72 |
| Pyinmana (1965-66) | - | - | 0.22 | 0.25 | 0.12 | - | 0.54 | 0.04 | 0.38 | 0.42 | 1.49 |
| Yamethin (1966-67) | - | 0.89 | 0.66 | 0.43 | 3.02 | - | 0.04 | 0.16 | 0.57 | 0.06 | 1.10 |
| Mandalay (1967-68) | - | 0.48 | 0.49 | 0.45 | 0.29 | - | 2.14 | 0.32 | 2.27 | 0.31 | 0.77 |
| E-Katha (1968-69) | - | 0.23 | 0.12 | 0.44 | 0.02 | - | - | 1.18 | 1.63 | 0.48 | 0.57 |
| U-Chindwin (1969-70) | - | 0.32 | - | 0.28 | 0.10 | 0.11 | - | 0.65 | 1.47 | 0.08 | 1.10 |
| Shwebo (1970-71) | - | 0.08 | 0.03 | 0.57 | - | - | 0.03 | 0.16 | 1.47 | 0.81 | 0.06 |
| W-Katha (1971-72) | - | 0.50 | - | 0.72 | 0.23 | - | - | 1.54 | 2.14 | 1.58 | 1.88 |
| U-Chindwin (1971-72) | - | 0.19 | 0.07 | 0.06 | - | - | - | 0.32 | 0.39 | 1.46 | 0.41 |
| Shwebo (1972-73) | - | 0.34 | 1.19 | 0.51 | 0.04 | - | 0.04 | 0.29 | 0.87 | 0.17 | 0.41 |
| Prome (1974-75) | 0.07 | 0.98 | 0.03 | 0.67 | 0.03 | 0.02 | 0.11 | 0.01 | 6.37 | 0.06 | 0.26 |

*Source: - Forest Department Inventory Survey

Appendix IV

Stock per acre 2' and over gbh in some forest divisions*

| species Division | Thinwin | Thitkado | Thitya | Yamane | Yindaik | Yinma | Yon | Zinbyun |
|-------------------------|---------|----------|--------|--------|---------|-------|------|---------|
| N-Toungoo (1964-65) | 0.15 | 0.04 | 0.62 | 0.09 | - | 0.03 | 0.52 | 0.23 |
| Pyinmana (1965-66) | 0.81 | 0.03 | 0.22 | 0.17 | - | 0.11 | 0.82 | 0.27 |
| Yamethin (1966-67) | 3.72 | 0.08 | 0.53 | 6.29 | 0.34 | 0.26 | 1.18 | 0.13 |
| Mandalay (1967-68) | 0.78 | 1.72 | 3.32 | 0.09 | 0.52 | 0.14 | 0.30 | 0.55 |
| E-Katha (1968-69) | 0.04 | - | 0.84 | - | 0.24 | 0.02 | 0.04 | 0.83 |
| U-Chindwin (1969-70) | 0.27 | 0.07 | 0.16 | 0.14 | 0.02 | 0.04 | 0.06 | 0.54 |
| Shwebo (1970-71) | 0.09 | - | 3.73 | 0.01 | 0.04 | 0.02 | 0.02 | 0.15 |
| W-Katha (1971-72) | 0.03 | - | - | 0.14 | - | 0.04 | 0.07 | 1.44 |
| U-Chindwin (1971-72) | 0.12 | - | 2.94 | 0.03 | - | 0.01 | 0.01 | 0.23 |
| Shwebo (1972-73) | 2.85 | - | 1.54 | 0.09 | 0.23 | 0.10 | 0.72 | 0.16 |
| Prome (1974-75) | 1.04 | - | 2.35 | 0.04 | 0.93 | 0.06 | 0.76 | 1.23 |

*Source: - Forest Department Inventory Survey

Note on Leza

| | |
|------------------------------------|---|
| Botanical Name | Lagerstroemia tomentosa Presl. |
| Trade Name | Leza (Burma), Salao (Thailand) |
| The Tree | A Large tree, attaining a height of 100 feet and over in favourable condition. A girth of 5 to 8 feet is normal, growing up to 10-12 feet in better sites. A Clear bole of 30-40 feet is common, but much fluted at the base in old trees. Found growing mostly in most part of the country, but in large quality in Lower Burma from Tanasseriam to the Pegu Yoma. Occurs in Moist Deciduous Upper Mixed Evergreen or semi-evergreen, and low-lying plain forests. In dry area, Leza is stunted. Liable to split quickly in felling and after felling. |
| The Timber Colour | No heart wood and colour of timber is yellowish-grey to uniformly brownish grey or light brown. Contact with rain turns to geryish black. Lustrous with smooth feel. |
| Grain | Straight grained, fine and even textured. |
| Specific gravity | .522 green and .545 air dry. A light timber with density of 64 lb/c. ft green and 42 lb/c. ft air dry. |
| Strength | Fairly strong. Similar to Binga, Hnaw and Pyinma but superior to Nabe, Sagawa, Taungthayet and Yemane. |
| Movement | Considerable. Shrinkage from green to oven dry is 4.2% radially and 6.4% tangentially. |
| Seasoning | Air seasons well and evenly with less degrade and takes about three months to get to 12% m. c. Kiln seasons easily, rapidly and consistently. The shrinkage on in kiln seasoning is moderate and the degrade is practically negligible. Classed as a non – refractory timber. |
| Working properties | Saw and machines easily, and works to a good surface, with a little picking up under the plane. |
| Polishing and staining | Polishes well and brought to a fine finish. |
| Durability and preservation | Fairly durable. Reported to last well in contact with water. It is said to be fairly difficult to treatment. |
| Uses | Could be used for resident building as posts, seantlings, flooring, paneling and joists. Useful as bolted timber and rollers. Furniture making is another use of Leza. A good timber with potential uses approaching to that of Pyinma. Should be treated for outdoor uses. |