

# Anatomical Features Red Meranti (*Shorea leprosula*, *Shorea parvifolia*) between Natural Forest with Intensive Silviculture

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## ABSTRACT

Less study has been carried out to characterize the tree growth and quality of lesser known and lesser used timber species grown in community forest or natural forest. In this study, two red meranti which grown from natural forest and intensive silviculture in central Kalimantan were identified their anatomical features. The objectives of this study are to find out the anatomical features of two red meranti (*Shorea leprosula*, *Shorea parvifolia*) between natural forest with intensive silviculture and also find out the variation anatomy properties such as texture, sapwood-heartwood ratio, juvenile periods on two red meranti (*Shorea leprosula*, *Shorea parvifolia*) from natural forest with intensive silviculture. Sample was taken from PT SBK in central Kalimantan at base stem with altitude 1.3 m from ground. Sample was made at each 1cm from pith to bark (radial direction). Sample preparation For fiber dimension, was made with size dimension 1mm x 1mm x 20mm, while proportion cell 1cm x 1cm x 1cm. Measurement of microfibril angle was used by polarized microscope and SEM. The results showed, macroscopic features of red meranti both from natural forest and intensive silviculture has same characteristics : vessel solitary, radial multiple, parenchyma scanty paratracheal, rays 1-2 distinct size, multiseriate, straight grain, resin canal concentric bands/tangential lines. Red meranti from intensive silviculture (*Shorea parvifolia* and *shorea leprosula*) has texture rather coarse till coarse compare with natural forest. *Shorea leprosula* and *Shorea parvifolia* from natural forest has thicker cell wall and also has smaller vessel diameter compared from intensive silviculture. Sapwood heartwood ratio red meranti from intensive silviculture has bigger sapwood than natural forest in *Shorea leprosula*.

Keywords : red meranti, silviculture intensive, natural forest, anatomical features, *Shorea parvifolia* and *shorea leprosula*

## INTRODUCTION

In the last decade the situation of Forestry in Indonesian has not been exhilarating. Ministry of Forestry reported that extensive deforestation occurs about 0.6 – 1.9 million ha between 2001 and 2005 (Ministry of Forestry, 2007). Meanwhile the logs production from natural forest decreased abruptly from around 19 – 30 million m<sup>3</sup> in the decade of 1991 – 2000 to be around 3.5 – 6.4 million m<sup>3</sup> between 2003 and 2007. This condition affects on the decreasing of production of plywood, sawntimber and other wood products due to the less supply of commercial timber species from natural forest.

Efforts have been carried out to overcome the lack of commercial timber supply. Forest plantations were built in several places with a total area of 335 thousand hectares in 2007 (Anonymous, 2007). In few forest concession companies, one of them are PT. Sari Bumi Kusuma, intensive silviculture is developed by strip planting system using various fast growing meranti.

Less study has been carried out to characterize the tree growth and quality of lesser known and lesser used timber species grown in community forest or natural forest. In this study, two red meranti which grown from natural forest and intensive silviculture in central Kalimantan were identified their anatomical features. The objectives of this study are to find out the anatomical features of two red meranti (*Shorea leprosula*, *Shorea parvifolia*) between natural forest with intensive silviculture and also find out the variation anatomy properties such as texture, sapwood-heartwood ratio, juvenile periods on two red meranti (*Shorea leprosula*, *Shorea parvifolia*) from natural forest with intensive silviculture.

## MATERIAL AND METHODS

### Research Materials

- c. Meranti wood (*Shorea leprosula*, *Shorea parvifolia*) from natural forest and intensive silviculture
- d. Alcohol (C<sub>2</sub>H<sub>5</sub>OH), Perhidrol (H<sub>2</sub>O<sub>2</sub>), Safranin
- e. Silol (C<sub>5</sub>H<sub>10</sub>), *Canada balsam*, aquadest and glacial acetic acid

### Research Tools:

- e. Chainsaw, cutter, loupe, microtomes, glass preparates, pipette
- f. Volumetric flash, digital scales, oven, desiccator, kaliper
- g. Test tube, object glass, hot plate, preparates box
- h. Microscope fluorescence BX 51 software *Image Pro Plus V 4.5*.

### Methods

#### 1. Sample Making

- Sample was taken from PT SBK in central kalimantan at base stem with altitude 1.3 m from ground.
- Sample was made at each 1cm from pith to bark (radial direction).
- For fiber dimension, sample was made with size dimension 1mm x 1mm x 20mm, while proportion cell 1cm x 1cm x 1cm

#### 2. Measurement Procedure

##### a. Macroscopic properties

- Observation of macroscopic properties by wathing carefully at transversal, radial and tangensial section with loupe 15-18x.

##### b. Microscopic properties

- Measurement cell proportion and fiber dimension are using software image pro plus 4.5

##### c. Sapwood and Heartwood Ratio

- Sapwood and heartwood ratio was calculate by compare wide area of sapwood and heartwood with total area transversal surface.

$(\% \text{Sapwood}) = \frac{TA - HA}{TA} \times 100\%$	$(\% \text{Heartwood}) = \frac{HA}{TA} \times 100\%$
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HA : Heartwood Area

TA : Total Area Transversal Surface

##### d. Wood Texture.

- Wood texture was determinated by using measurement vessel diameter and fiber diameter.
- Criteria of size dimension of vessel diameter and fiber diameter as follows :

Wood Texture	Vessel diameter	Fiber diameter
Fine (Smooth)	< 100 μ	< 30 μ
Moderate	100 – 200 μ	30– 45 μ
Coarse	> 200 μ	> 45 μ

##### e. Juvenile Period

- Determination juvenile period was using analysis the graph of fiber length at radial direction from pith to bark.

## RESULT & DISCUSSION

### A. Macroscopic and Microscopic Features of Red Meranti

Table 1. Macroscopic features of red meranti

Wood Features	Natural forest (Nf)		Intensive Silviculture (Is)	
	<i>S. leprosula</i>	<i>S. parvifolia</i>	<i>S. leprosula</i>	<i>S. parvifolia</i>
Vessel				
• Distribution	Solitary, multiple radial	Solitary, multiple radial	Solitary, multiple radial	Solitary, multiple radial
• Diameter	160.36 $\mu$	182.10 $\mu$	175.22 $\mu$	208.07 $\mu$
Parenchyma	Concentric bands, Vasicentric, scanty paratrakeal			
Rays				
• Size	2 Distinct size	1size	2 Distinct size	2 Distinct size
• width (t)	Multiseriate	Multiseriate	Multiseriate	Multiseriate
Grain orientation	Straight Interlocked	Straight Interlocked	Straight Interlocked	Straight, Interlocked
Canal resins				
• Present	Present	Present	Present	Present
• Distribution	Concentric bands	Tangential lines	Concentric bands	Tangential lines

Macroscopic features of red meranti has sapwood colour pale yellowish white, pale yellow while the heartwood colour pale pinkish yellow, pale pinkish Brown, dark brown or reddish Brown. Growth ring is appear some times not according to the species.. Vessel solitary and multiple radial 2-3, Grain orientation usually straight some times interlocked..

Rays multiseriate 1-5 seriate. Rays shows 2 distinct sizes (*Shorea leprosula* both Nf and Is, *Shorea parvifolia*-Is) and shows 1 size in *Shorea parvifolia*-Nf (Fig. 1).

Axial parenchyma usually scanty paratrakeal or vasicentric surrounding vessel according to the species or specimen. Axial parenchyma also founded in concentric bands surrounding the axial resin canals.

Axial resin canals in more or less continuous tangential lines at interval 0,2 to 0,5 mm (Fig. 2). Usually axial resin canals present or not according to the species or specimen. Table 2 shows that axial resin canals present in all red meranti (*Shorea leprosula*, *Shorea johorensis*, *Shorea parvifolia*. and *Shorea platyclados*) but some times not present in *Shorea leprosula*.(Fig. 2).

Table 2. Fiber dimension

Red Meranti	Source	Fiber length (mm)	Fiber diameter ( $\mu$ )	Lumen diameter ( $\mu$ )	Cellwall Thickness ( $\mu$ )
<i>Shorea leprosula</i>	Intensive silv	1,042	22,68	19,04	1,820
	natural forest	1,081	22,88	18,84	2,020
<i>Shorea parvifolia</i>	Intensive silv	1,095	21,65	17,94	1,851
	natural forest	0,955	27,16	23,15	2,005

Microscopic features: Vessel frequency 3-8/mm<sup>2</sup> usually 3-5 / mm<sup>2</sup> . Maximum tangential diameter of solitary vessel is 208 $\mu$  (*Shorea parvifolia*) with minimum tangential diameter 175  $\mu$  (*Shorea johorensis*). Vessel proportion 7,85-11,76% (*S.parvifolia* the highest; *Shorea platyclados* the lowest). diameter 175,22-208,07 (*S.parvifolia* the biggest);

Rays multi seriate with range 1-3 to 1-8 seriate mostly 1-3 to 1-5 seriate according to the species or specimen. Sometimes rays also has tendency to 2 distinct sizes (*Shorea platyclados* ; *Shorea johorensis*). Rays proportion 12,16 - 16,67%. Highest proportion rays 16,67% (*Shorea johorensis*) and lowest 12,16 % (*Shorea leprosula*)

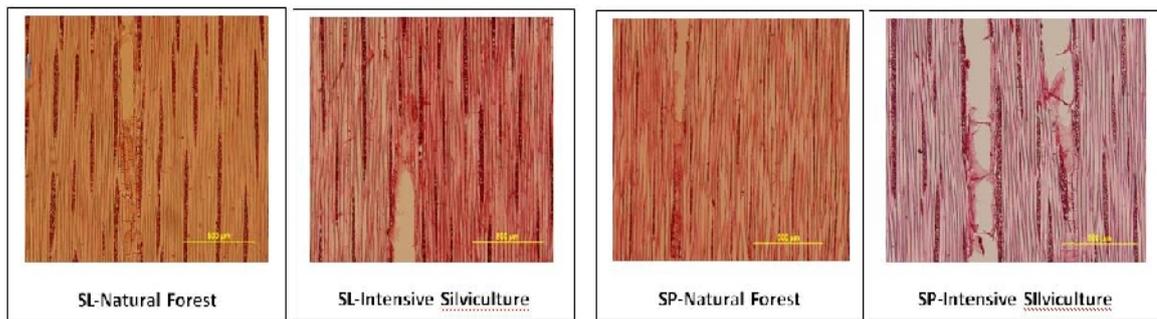


Figure 1. Tangential surface red meranti from natural forest and intensive silviculture

Tabel 3. Cell proportion of red meranti

Red Meranti	Source	Vessel (%)	Parenchyma (%)	Rays (%)	Fiber (%)	Resin canals (%)
<i>Shorea leprosula</i>	Intensive silv	8.34	14.70	12.16	63.85	1.05
	natural forest	7.85	13.09	12.99	65.27	0.78
<i>Shorea parvifolia</i>	Intensive silv	11.75	13.75	14.01	59.38	1.04
	natural forest	8.012	11.70	11.35	68.01	0.90

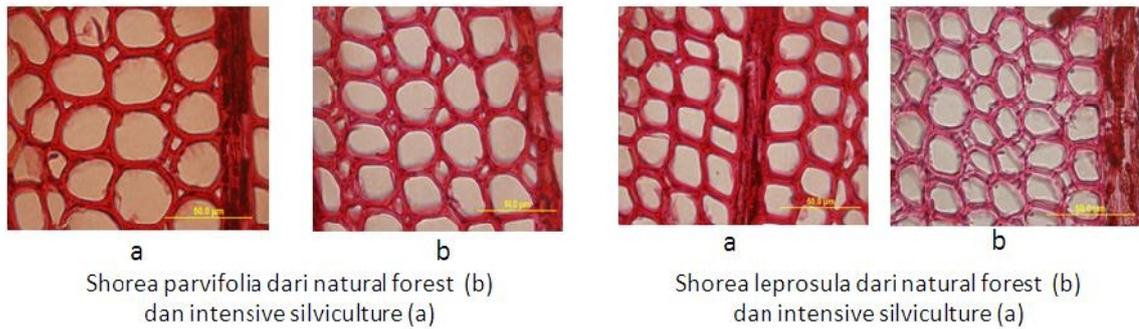


Figure 2. Transversal surface red meranti from natural forest and intensive silviculture

Cell proportion, fiber is dominant compare other cell, up than 50%. The range fiber proportion is about 59,37-65,27%. The highest fiber proportion 65,27% (*Shorea platyclados*) with minimum fiber proportion 59,37% (*S.parvifolia*). Fiber length red meranti 0,88-0,91mm (*Shorea platyclados* the longest; *Shorea johorensis* the shortest).; Diameter is about 20,51-22,68 $\mu$ . Cell wall thickness is about 1,76-1,84 $\mu$ .

Axial parenchyma proportion is about 11,73-14,71%. Highest proportion axial parenchyma founded in *Shorea leprosula* (14,71%) the lowest proportion in *Shorea johorensis* (11,73%). Axial parenchyma usually scanty paratracheal or vasicentric surrounding vessel or diffuse according to the species or specimen. Axial parenchyma also founded in concentric bands surrounding the axial resin canals.

#### B. Sapwood & Heartwood Ratio of Red Meranti

Tabel 4. Sapwood & Heartwood Ratio of Red Meranti

Red Meranti	Source	Sapwood (%)	Heartwood (%)
<i>Shorea leprosula</i>	Intensive silviculture	75.09	24.91
	natural forest	55,78	44,22
<i>Shorea parvifolia</i>	Intensive silviculture	64.40	35.60
	natural forest	64.10	35.90

Measurement result of sapwood heartwood ratio red meranti from intensive silviculture has bigger sapwood than natural forest in *Shorea leprosula*. Heartwood and sapwood ratio from the table above shows that heartwood proportion is lower than sapwood in all red meranti species both from intensive silviculture and natural forest.. Maximum heartwood ratio is 44.22 % (*Shorea leprosula* from natural forest) with minimum heartwood ratio 24,91 % (*Shorea leprosula* from natural forest). Maximum sapwood ratio is 75.09 % (*Shorea leprosula* from natural forest) with minimum sapwood ratio 55,78 % ((*Shorea leprosula* from natural forest).

Sapwood & Heartwood Ratio is has significant different on *shorea leprosula* between intensive silviculture and natural forest, but not different on *shorea parvifolia*

### C. Wood Texture of Red Meranti

Table 5. Clasification WoodTexture of Red Meranti

Red Meranti	Source	Vessel Diameter	Fiber Diameter	Texture
<i>Shorea leprosula</i>	Intensive silviculture	175.22 $\mu$	22.68 $\mu$	Fine to rather coarse
	natural forest	160.36 $\mu$	22.88 $\mu$	Fine to rather coarse
<i>Shorea parvifolia</i>	Intensive silviculture	208.07 $\mu$	21.67 $\mu$	Fine to rather coarse
	natural forest	182.10 $\mu$	27.16 $\mu$	Fine to rather coarse

Based on vessel diameter, red meranti from intensive silviculture (*Shorea parvifolia* and *shorea leprosula*) has texture rather coarse till coarse compare with natural forest which has texture moderate/medium. Based on fiber diameter, red meranti both from natural forest and intensive silviculture (*Shorea parvifolia*) has average diameter below 30 $\mu$ , so that all of red meranti has fine texture.

### E. Juvenile Periods of Red Meranti

Tabel 6. Fiber length of *S. leprosula* from pith to bark

Red Meranti	Source	Fiber Length							
		R1	R2	R3	R4	R5	R6	R7	R8
<i>Shorea leprosula</i>	Intensive silviculture	0.903	0.953	1.023	1.015	1.031	1.104	1.126	1.179
	natural forest	0.901	0.946	0.979	1.077	1.15	1.192	1.196	1.198

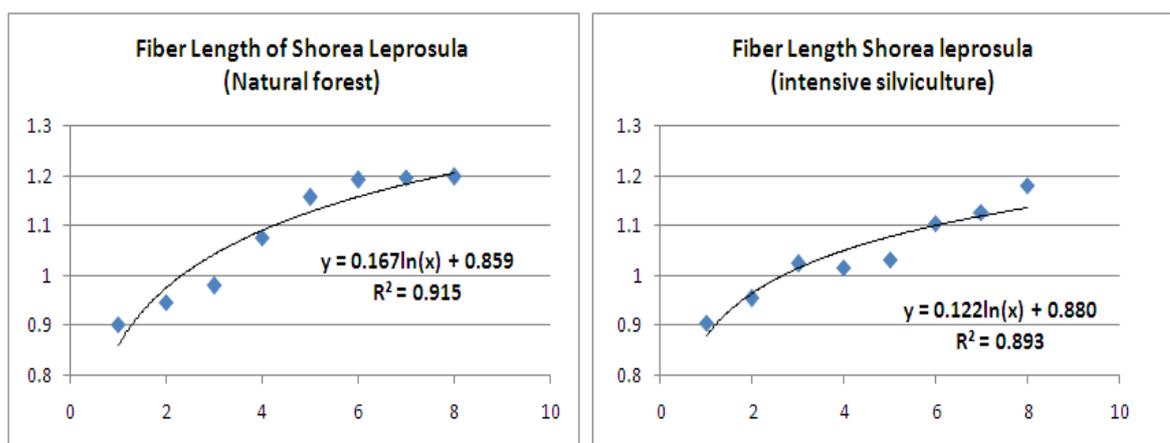


Figure 3. Fiber length of *S. leprosula* from natural forest and intensive silviculture

Red meranti (*Shorea leprosula*) both from natural forest and intensive silviculture has minimum fiber length (0,09mm) near the pith and maximum fiber length near the bark (1,2mm) . The fiber length shows gradually increase from pith to bark. The graph of red meranti above (Fig. 3) shows that fiber length

of *Shorea leprosula* both from natural fores and intensive silviculture still increase from pith to bark. It is indicate that red meranti *Shorea leprosula* are still in juvenile periods

Tabel 7. Fiber length of *S. parvifolia* from pith to bark

Red Meranti	Source	Fiber Length								
		R1	R2	R3	R4	R5	R6	R7	R8	R9
<i>Shorea parvifolia</i>	Intensive silviculture	0.878	0.965	1.00	1.06	1.103	1.120	1.142	1.156	1.170
	natural forest	0.779	0.881	0.903	0.918	0.934	0.951	1.031	1.036	1.038

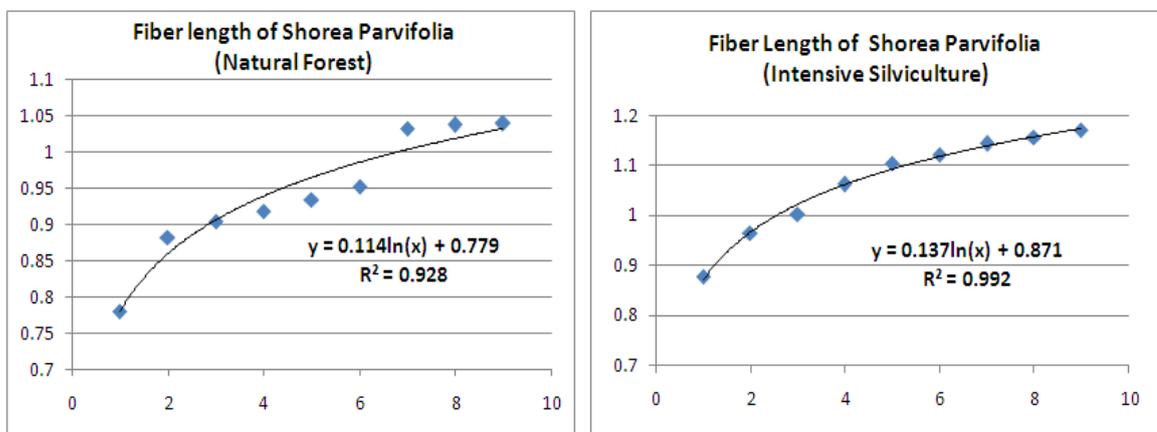


Figure 4. Fiber length of *S. parvifolia* from natural forest and intensive silviculture

Red meranti both from natural forest and intensive silviculture has minimum fiber length (0,78-0,87mm) near the pith and maximum fiber length near the bark ( 1.0-1,2mm) . The fiber length shows gradually increase from pith to bark. The graph of red meranti above (Fig. 4) shows that fiber length of *S. parvifolia* both from natural fores and intensive silviculture still increase from pith to bark. It is indicate that red meranti *S. parvifolia* are still in juvenile periods

## CONCLUSIONS

- Macroscopic features of red meranti both from natural forest and intensive silviculture has same characteristics : vessel solitairy, radial multiple, parenchyma scanty paratracheal, rays 1-2 distinct size, multiseriate, straight grain, resin canal concentric bands/tangential lines.
- Microscopic features red meranti has 2 differences between natural forest and intensive silviculture that is cell wall thickness and vessel diameter. Both shorea leprosula and shorea parvifolia from natural forest has thicker cell wall and also has smaller vessel diameter compared from intensive silviculture.
- Result of sapwood heartwood ratio red meranti from intensive silviculture has bigger sapwood than natural forest in *Shorea leprosula* . But it's not different in *shorea parvifolia*.
- Based on vessel diameter, red meranti from intensive silviculture (*Shorea parvifolia* and *shorea leprosula*) has texture rather coarse till coarse compare with natural forest which has texture moderate/medium. Based on fiber diameter, red meranti both from natural forest and intensive silviculture (*Shorea parvifolia*) has average diameter below 30 $\mu$ , so that red meranti has fine texture.

## REFERENCES

- Desch, H.E. 1941. Dipterocarp Timber of The Malay Peninsula. Malayan Forest Rec. No. 14:171 pp
- Kessler, P.J.A dan Sidiyasa, K. 1999. Pohon-Pohon Hutan Kalimantan Timur. Pedoman Mengenal 280 jenis Pohon Pilihan di daerah Balikpapan-Samarinda. Tropenbos. Kalimantan.
- Kretschmann, D. E., 1997. Variations of microfibril angle of Loblolly pine. comparison of iodine crystallization and x-ray diffraction. Properties of Juvenile Wood. <http://www.fpl.fs.fed.us/>
- Ogata, K., T.Fujii, H.Abe, P. Baas. 2008. Identification of The Timbers of Southeast Asia and Western Pacific. Kaiseisha Press. Japan.
- Pandit, I.K.N. , 2000. Metoda Identifikasi Kayu Juvenil. Seminar Nasional III, Masyarakat Peneliti Kayu Indonesia. Jatinangor, Sumedang.
- \_\_\_\_\_. 2000. Sifat Makroskopis Kayu Jati (*Tectona grandis* L.f) pada Berbagai Kelas Umur. Prosiding Seminar MAPEKI III.