SAWING RECOVERY OF SEVERAL SAWMILLS IN JEPARA

(Rendemen Penggergajian Beberapa Kilang Penggergajian di Jepara)

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ABSTRAK

Dalam situasi kekurangan bahan baku, para pengrajin furnitur harus memanfaatkan kayu secara efisien. Peningkatan efisiensi yang bertujuan untuk meningkatkan nilai tambah industri kecil menengah (IKM) furnitur di Jepara perlu dilakukan sejak tahap pertama pengolahan kayu, yaitu penggergajian yang mengkonversi log menjadi kayu gergajian.

Penelitian telah dilakukan terhadap peningkatan angka rendemen kayu gergajian melalui pembuatan papan jeblosan sebagai bahan baku furnitur di Jepara. Pola penggergajian yang digunakan adalah pola satu sisi. Penelitian dilakukan dengan melakukan pengukuran angka rendemen dari proses penggergajian selama satu hari penuh di setiap kilang dari empat sampel industri penggergajian dan satu pengrajin yang menggergaji kayu dengan gergaji rantai.

Hasil penelitian menunjukkan bahwa angka rendemen dari kilang penggergajian di Jepara mencapai 70 - 80 %. Angka ini relatif lebih tinggi karena pola penggergajian yang digunakan adalah pola satu sisi dan kayu gergajian yang dihasilkan tidak mengalami perataan sisi atau digergaji ulang menjadi papan persegi. Dibandingkan dengan ketentuan yang dikeluarkan pemerintah, kilang penggergajian di Jepara telah mempraktekan penggergajian yang efisien.

Keyword : Rendemen penggergajian, papan jeblosan, bahan furnitur, jepara

ABSTRACT

In the situation of wood material shortage, it is important to furniture manufacturers to efficiently utilize the wood. Increasing efficiency for improving value added of small medium enterprises of wood furniture industries in Jepara should be carried out from the first stage in wood processing: sawing that will convert logs into sawn timber.

A study has been carried out on improving sawing recovery of sawntimber by live-sawing pattern to make loseware lumber for furniture material in Jepara region. This study was done by investigating the current sawing recovery data as determined during one full day's processing at each of the four bandsaw mill facilities and one chainsaw/carving facility.

The results indicate that the current recovery rate of sawmilling services companies in Jepara reached 70 - 80 %. These recoveries are relatively high due to the live sawing pattern used and the fact that sawn boards were not edged or resawn into square pieces at the mill. Compared to existing rules and the Government standard for calculating the recovery rate, sawmilling service companies in Jepara have practiced efficient processing in sawing.

Kata kunci : Sawn-recovery, live-sawing, loseware lumber, furniture material, Jepara

I. INTRODUCTION

Jepara has been well known as a centre of wood carving and furniture industries in Indonesia due to of uniqueness of the products. As a result, such industries bring Jepara to be well recognised both in domestic market and worldwide. Roda et al. (2007) stated that the reputation has driven to a large extent the economics activities related to wood production and processing, particularly to furniture manufacturing. the industry has created a focal point for developing additional activities and industries. Besides serving a huge Indonesian domestic market, Jepara also supplies overseas market, such as USA, Europe, Japan, Honkong and Australia, and consequently it takes the role of the bridge between local community, forest and global market. Although Jepara has become an established furniture industries centre, Ozarska et al. (2010) reported that significant improvements and developments are necessary to make the Jepara Furniture Industry competitive on overseas markets, numerous opportunities can be identified which indicate that the industry has a good chance of succeeding.

Increasing efficiency for improving value added of small medium enterprises of wood furniture industries in Jepara should be carried out from the first stage in wood processing: sawing that will convert logs into sawn timber. Based on the sawmill owners claim, Anon. (2010d) reported that Jepara sawmills achieved high recoveries of approximately 80%. However, there is no clear records of their achievements. This report presents results of the study on the current recovery rate as observed in 5 (five) sawmill services in Jepara. For this report the definition of efficient processing excludes variables other than green-off-saw recovery.

II. METHODOLOGY

A. Research Location

There are limited sawmilling companies that serve many furniture enterprises in Jepara, so the investigated companies can represent most of the sawmills there. Current sawing recovery data were determined by one shift (8 hours) processing at each of the four bandsaw mill facilities and one chainsaw/carving facility in Jepara. All the investigated companies are coded as I, II, III, IV, and V. More information regarding the nominated industry champion sawmilling companies could refer to ACIAR Project FST/2006/117 Report 2.1 (Anon. 2010d).

B. Material

Four wood species were sawn during the recovery investigation as can be seen in Table 1.

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Table 1. Wood species sawn
Tabel 1. Jenis kayu yang digergaji

Codes of sawmilling companies	Wood species
I.	Teak (*Tectona grandis*)
II.	1. Teak (*Tectona grandis*) 2. Mahogany (*Swietenia* sp) 3. Mango (*Mangifera* sp)
III.	Teak (*Tectona grandis*)
IV.	1. Teak (*Tectona grandis*) 2. Mahogany (*Swietenia* sp)
V.	Trembesi (*Samanea saman*)

C. Method

The main activity for determining recovery rate of the sawn timber is measurement of log volumes as the input and sawn timber volumes as the output. Log measurements on the beginning (large end, dp) and the end of each log (small end, du) were undertaken twice per each cross section of the logs: the longest (d1) and the shortest (d2) diameters for the log-base and the longest (d3) and the shortest (d4) for the log-end. Log diameter (D) was then calculated as the average of the base and the end of log diameters. The length of logs (L) was measured to provide the final factor to calculate the volume for each (V_i) (Rachman et al., 2003; Rachman & Malik, 2011; Anon., 2010a). For the sawn board output, the length (P) was measured once while the width and the thickness were measured three times on each sawn board as can be seen in Figure 1.

$$dp = \frac{d1 + d2}{2} \quad .... (1)$$

$$du = \frac{d3 + d4}{2} \quad .... (2)$$

$$D = \frac{dp + du}{2} \quad .... (3)$$

$$V_i = 0.25 \, D^2 P \quad .... (4)$$
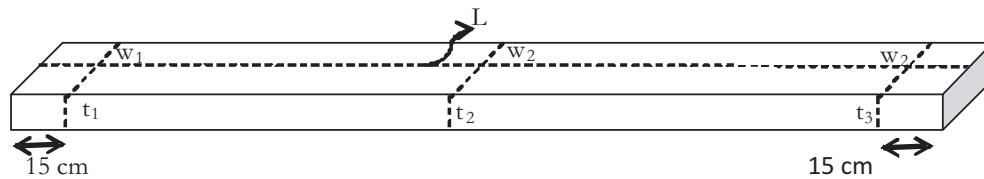

Figure 1. Measurement method for sawn timber
Gambar 1. Metode pengukuran kayu gergajian

From the above measurements, the averages of width (w) and thickness (t) can be calculated using formula (5) and (6), and then the volume of each piece of the sawn timber (V_{oi}) is determined as follows:

average width $w \quad \dfrac{w_1 \quad w_2 \quad w_3}{3}$ .... (5)

average thickness $t \quad \dfrac{t_1 \quad t_2 \quad t_3}{3}$ .... (6)

$V_{oi} \quad P.w.t$ .... (7)

Volume of the sawn boards for furniture loseware lumber (Vo) is a total of Voi:

$Vo \quad \sum_{i\ 1}^{n} V_{oi}$ .... (8)

where: n = number of sawn timber boards.

The sawn timber recovery from each sawn out log (Ri) is determined by:

$Ri \quad \dfrac{Vo}{Vi} x\,100\%$ .... (9)

The recovery rate from all the studied sawn out logs (R) is calculated as the average of Ri::

$R \quad \dfrac{\sum_{i\ 1}^{n} Ri}{n}$ .... (10)

where: n = number of sawn out logs

Specifically for sawing in carving produced by Sholikin, the recovery was determined by comparing the weight of semi finished products as output (Wo) with their original material mass (Wi) due to difficulties to measure the irregular shaped output. It was assumed that the change in mass due to moisture loss would be negligible and therefore no adjustment was taken into account for moisture content difference between the initial log measurement and semi-finished product weighing. Therefore, the recovery was calculated as:

$R \quad \dfrac{w_o}{w_i} x\,100$ .... (11)

III. RESULTS AND DISCUSSION

A. Wood Species

According to the previous sawing assessment described in Project Report 2.1 (Anon. 2010d), there are many species sawn in sawmilling services in Jepara. The services only process wood from the customers and as a consequence it is possible the sawn wood species can change depending on availability of resource. However, teak and mahogany are still the most favorable common species.

B. Sawing Pattern and Sawn Timber

During this investigation, the sawing pattern used by the four sawmilling services companies is live sawing. According to Ginoga *et al.*, (1999), this pattern is fit to be used for small diameter logs such as those typically used by the Jepara industry. This pattern is the simplest sawing method, the easiest to apply and obtains higher green-off-saw recovery rates as well as faster sawing time than alternative and more complex patterns which involve more handling time, for example turning the log. Nevertheless, Rachman and Malik (2011) stated that the live sawing pattern generally produces sawn timber with low quality due to flat sawn timber that is susceptible to change its dimension (crook) and damage (crack) during the drying process. This method is often not suitable for fast-grown logs containing high levels of growth stress. Such logs need a more balanced sawing pattern to minimise degrade or splits as stresses are relieved.

The range of thicknesses of the sawn timber accords with the lumber uses in the furniture products, such as the lumber thickness 1 or 1.5 cm used for making ornament, 3 cm for table top components, and 4 cm for table and chair legs. The different lumber thicknesses are in accordance with the customers' specifications.

Except Company-V who uses a chainsaw, each sawmilling company uses bandsawing equipment in a through-and through or live sawing pattern as shown in Figure 2. This pattern produces flat sawn timber type which is desirable for species such as teak to display the grain to best effect. No edging or resawing to make square was undertaken, therefore, the boards still have sapwood along both board edges. According to Indonesian Standard SNI 7537.1:2010, the lumbers called as loseware lumber (Figure 3). In Company-V, logs were converted directly into the semi finished product using a chainsaw to sculpt out the primary shape of the finished, hand-carved product (Table 2e).
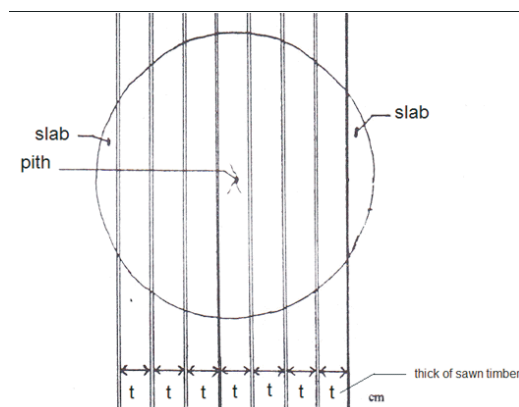

Figure 2. Live sawing pattern
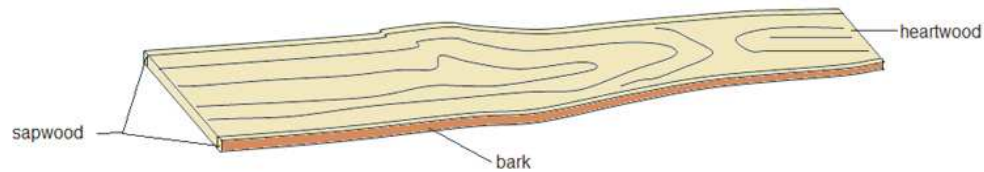*Gambar 2. Pola penggergajian satu sisi*

Figure 3. Loseware lumber
Gambar 3. Papan jeblosan

C. Recovery Rates

Results from the measurements logs dimensions and the recovery rates are shown in Tables 2a to 2e.

Table 2a. Log dimension and recovery rate of the sawn timber of sawmill company I
Tabel 2a. Dimensi dolok dan rendemen kayu gergajian di kilang penggergajian I

Species: Teak (*Tectona grandis,* 44 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm³)	Volume of sawn timber each log (cm³)	Recovery (%)
Minimum	21.5	130	47722.73	35537.67	61
Maximum	37.0	300	271912.25	200775.00	85
Average	27.8	198	125506.01	94038.88	75
Standard deviation	4.9	38	54720.35	39850.09	6

Table 2b. Log dimension and recovery rate of the sawn timber of sawmill company II
Tabel 2b. Dimensi dolok dan rendemen kayu gergajian di kilang penggergajian II

Species: Teak (*Tectona grandis,* 6 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm³)	Volume of sawn timber each log (cm³)	Recovery (%)
Minimum	22.6	134	72482.48	63038.67	77
Maximum	28.5	253	131986.64	109841.10	87
Average	25.7	202	104111.41	83776.33	81
Standard deviation	1.9	45.5	24925.95	18951.13	4

Species: Mahogany (*Swietenia* sp., 11 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm³)	Volume of sawn timber each log (cm³)	Recovery (%)
Minimum	20.6	137	64206,72	43452.00	61
Maximum	34.5	275	143889,32	114960.00	82
Average	27.5	198	116238,36	87289.53	71
Standard deviation	3.5	47.3	28458.19	24421.74	7

Species: Mango (*Mangifera* spp. , 5 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm³)	Volume of sawn timber each log (cm³)	Recovery (%)
Minimum	24.1	104	47515.76	36576.80	62
Maximum	50.6	136.	253495.51	221718.00	87
Average	35.0	124	132432.64	110020.16	80
Standard deviation	11.2	12.6	87585.75	80686.05	11

Table 2c. Log dimension and recovery rate of the sawn timber of sawmill company III

Tabel 2c. Dimensi dolok dan rendemen kayu gergajian di kilang penggergajian III

Species: Teak (*Tectona grandis*, 54 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm³)	Volume of sawn timber each log (cm³)	Recovery (%)
Minimum	11.5	190	20944. 25	14388	59
Maximum	22.5	250	79481.25	65800	83
Average	16.7	202	45211.16	31930.81	70
Standard deviation	2.4	7.5	13411.71	11144.47	6

Table 2d. Log dimension and recovery rate of the sawn timber of sawmill company IV -

Tabel 2d. Dimensi dolok dan rendemen kayu gergajian di kilang penggergajian IV

Species: Teak (*Tectona grandis,* 22 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm^3)	Volume of sawn timber each log (cm^3)	Recovery (%)
Minimum	19.6	130	53363.86	40534.00	57
Maximum	30.0	220	136629.25	103566.67	89
Average	25.2	179.6	90639.15	68711.14	77
Standard deviation	3.1	26.3	26016.69	18234.31	7

Species: Mahogany (*Swietenia* sp., 16 logs)

	Diameter (cm)	Length (cm)	Volume of log (cm^3)	Volume of sawn timber each log (cm^3)	Recovery (%)
Minimum	19.8	120	54259.20	36576.00	60
Maximum	32.1	252	183900.02	71988.00	75
Average	25.1	182.7	91620.52	67650.10	72
Standard deviation	3.4	37.3	33760.67	31030.76	7

Table 2e. Log dimension, and recovery rate of the of sawmill company V

Tabel 2e. Dimensi dolok dan rendemen kayu gergajian di kilang penggergajian V

Species: Trembesi (*Samanea saman*)

No	Type of products	Material (log) size				Products weight[1] (kg)	Recovery[2] (%)
		Length (cm)	Diameter (cm)	Weight (kg)	Volume (cm^3)		
1	Crab big size	135	70	258	519277.5	163	63
2	Elephant	120	70	258	461580	198	77
3	King crab	150	80	300	753600	195	65
4	Rose table	40	80	50	200960	35	70
5	Crab A	125	65	136	414578,1	106	78

Remarks: 1. Semi finished product; 2. Based on the weight change
Keterangan: 1. Produk setengah jadi; 2. Berdasarkan perubahan berat

Tables 2a to 2d show the highest and the lowest recovery rates from all four sawmilling companies where the highest recovery is 80% and the lowest is 57%. These recoveries are high rates of sawn timber recovery due to the live sawing pattern used and the fact that the

sawn timbers were not edged or resawn into square pieces. These results consolidate the recovery rate estimated by industry champions which claimed the recovery of 80%. However in this study, the sawmill (IV) recovery rates are lower than 80% : 77% for teak and 72% for mahogany. There are several factors affecting recovery rate, such as dimension, straightness, taper, logs quality, kerf, target size, personnel, condition and maintenance of the machines, and sawing pattern (Rachman and Malik, 2011) as well as method for calculation.

As mentioned in the method above, board thickness and the width in this study was measured three times for each dimension and the average used for the recovery calculation. This way is different to the SNI method where the principle of measurement taken is the lowest value. For the example, from Company-IV obtained measuring result data as shown in Table 3 below

Table 3. Data sample from company IV for comparing obtained recovery rate with measuring based on SNI

Tabel 3. Data dari kilang penggergajian IV untuk membandingkan angka rendemen yang diperoleh dengan metode pengukuran berdasarkan SNI

a.   Log dimension

| No. Log | Diameter (cm) | | | | | Length (cm) | Volume (cm^3) |
| | Base | | End | | Average | | |
	d1	d2	d3	d4			
3	24	21	20	19	21	201	69583.19

b.   Measured sawn timber and its recovery from teak log 3

| No Lumber | Length (cm) | Width | | | | Thick | Volume (cm^3) | Recovery (%) |
		Base	Middle	End	Average			
3.1	201	10	7	15	10.67	2	4288	
3.2	201	17	10	19	15.33	2	6164	
3.3	201	24	19	20	21	8	33768	
3.4	201	19	19	24	20.67	2	8308	
3.5	201	15	16	24	18.33	2	7370	
							59898	86

c.   Measuring the sawn timber and the recovery based on SNI

No Lumber	Length (cm)	Width	Thick	Volume (cm³)	Recovery (%)
3.1	201	7	2	2814	
3.2	201	10	2	4020	
3.3	201	19	8	30552	
3.4	201	19	2	7638	
3.5	201	15	2	6030	
				51054	73

Based on Table 3 part b and c, there is significant difference between this study result and SNI 7537.2:2010. The difference is approximately 13%. The current recovery in this study is higher than the recovery calculated based on SNI dimension measurement because of no edging or resawing before manufacturing furniture components.

Furniture manufacturers in Jepara re-cut their sawn timber to match the size of the furniture components required for orders. If they will require narrow components, they will cut the narrow lumber. If the lumber is made square first before manufacturing the components, it will make the slabs larger (Figure 4). Referring to the recovery rate and their practices, it could be stated that the sawmilling services companies have been efficient in the sawing stage of furniture production processes as far as recovery is concerned. Other measures of efficiency such as productivity, wastes and profitability were outside the scope of this study.
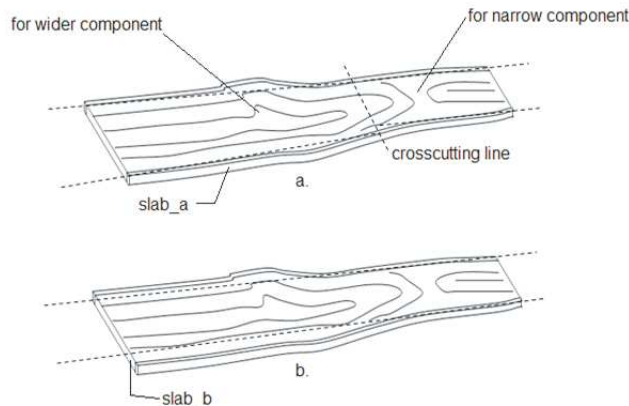

Figure 4.   Cutting method for making furniture components: a. Current method, b. Making square prior to make component

Gambar 4. Metode pemotongan papan dalam pembuatan komponen furnitur: a. Metode yang digunakan pengrajin saat ini; b. Pembuatan papan persegi sebelum membuat komponen

If this current recovery rate of sawmilling services in Jepara is compared to sawing recovery rate from the Rule of Director General of Forest Production Management, Ministry of Forestry, Republic of Indonesia No. 13/2009, this current sawing recovery rate in Jepara is higher. The DG ruled that the sawn timber recovery of small diameter logs from plantation forest are to be within the range 61 to 77% (Anon., 2009). It is difficult to compare these rates with the published recovery data for other plantation species due to the difference in sawing patterns. For example a study on four plantation eucalypts aged from 11 to 14-years-old in Argentina (Hopewell, 2002) provided an average green-off-saw recovery of 35.7%, less than half achieved by the Jepara sawmills for similar sized logs. The difference is attributed to different sawing patterns, where the Argentinean material was sawn into edged boards, resulting in higher waste at the sawmilling stage. In the Jepara situation, the re-sawing is conducted at a latter stage of processing, by the furniture manufacturer.

IV. CONCLUSION

1. Current recovery rate of sawmilling services companies in Jepara reached 70 - 80 %. These recoveries are relatively high due to the live sawing pattern used and the fact that sawn boards were not edged or resawn into square pieces at the mill.
2. Comparing to existing rules and the Government standard for calculating the recovery rate, sawmilling service companies in Jepara have practiced efficient processing in sawing. For this report the definition of efficient processing excludes variables other than green-off-saw recovery.

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BIBLIOGRAPHY

Anon. 2009. Rule of Director General of Forest Production Management No. P.13/VI-BPPHH/2009 dated 9 November 2009 about Recovery of Processed Wood of Primary Forest Products Industry. Jakarta.

Anon. 2010a. SNI 7533.1:2010 Log Part-1: Term and Definition. National Standardization Agency of Indonesia, Jakarta (in Indonesian Language).

Anon. 2010b. SNI 7537.2:2010 Sawn Timber Part-2 Dimension Measurement. National Standardizatioan Agency of Indonesia, Jakarta (in Indonesian Language).

Anon. 2010c. SNI 7537.1:2010 Sawn Timber Part-1 Term and Definition. National Standardizatioan Agency of Indonesia, Jakarta (in Indonesian Language).

Anon. 2010d. Jepara Sawmilling Assessment. ACIAR Project FST/2006/117 report no 2.1.

Ginoga, B. O. Rachman and J. Malik, 1999. Technical Guideline for Sawing on Small Log Diamater. Centre for Forest Products and Forestry Socio-economical Research and Development, Bogor (in Indonesian Language).

Hopewell, G. 2002. Sawing recovery and utilisation potential of fast-grown Argentinean eucalypts. FWPRDC Cullity Fellowship Report.

Ozarska, G. Hopewell, J. Norton, G. Harris and W. Darmawan. 2010. General Assessment. ACIAR Project FST/2006/117 report no 2.1.

Rachman, O. S. Kliwon, N. Hadjib, J. Malik, A. Santoso, I.M. Sulatiningsih, and M.I. Iskandar, 2003. Study on recovery rate for sawn timber and plywood and their secondary products. Project Report. Forest Products Research and Development Centre, FORDA. Bogor.

Rachman, O. and J. Malik, 2011. Wood Sawing and Machining for Indonesian Wood Industries. FORDA, Jakarta (in Indonesian Language).

Roda, Jean-Marc, P. Cadène, P. Guizol, L. Santoso, and A. U. Fauzan. 2007. Atlas Industri Mebel Kayu di Jepara. French Agricultural Research Centre for International Development. Montpellier.