Potency of Waste Biomass for Energy Production in Bengkulu Province

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ABSTRACT

The Indonesian ambassador for Japan at a public lecture at the University of Bengkulu in 2014, mentioned that based onseveral preliminary survey of waste biomass such as midrib of palm oil tree, the Japanese government plans to establish an industry to process the to produce energy in Bengkulu Province, Information about the weight of midrib per unit time is needed to implement the industry, Unfortunately, until now the information is not yet available, The purpose of this study was to calculate the weight of the midribs per unit time in Bengkulu Province, The study was conducted by calculating the number of the midribs in Bengkulu Province, and then converts them into weight per time, Results showed that weight midribs was 653,476 tons/month or 21,079,88 ton/day, This means that in the raw material point of view, in the Bengkulu Province issue table to establishing an energy industry within put capacity up to21,079,88 tons midrib/ day, Other waste potential sources of raw materials in Bengkulu Province, namely Empty Fruit Bunches and trunks of rubber trees to be felled.

Key words: bioenergy, energy industry, midrid, palm oil tree

INTRODUCTION

Biomass becomes one of the alternative energy sources in the future since it is renewable and maitain low level emission (Prasertsana and Sajjakulnukit, 2006; Zeng *et al*,, 2007; Searcy *et al*,, 2007; Christopher *et al*,, 2008; Riyanti, 2009), A number of modern technologies have been developed to increase calorific value from biomass through pyrolysis (Mohan *et al*,, 2006; Bridgwater, 2012; Ceyhan *et al*,, 2013; Hwang et al,, 2014; Kawamoto *et al*,, 2015; Matsuoka *et al*,, 2014),

Biomass is organic material produced by photosynthesis, either the product or the waste (McKendry, 2002), including midrib from palm oil plantations, Globally, biomass is able to provide 11% of world primary energy (Dobermann, 2007), Waste biomass from oil palm plantations can produce around 67 million GJ of energy (Abdullah, 2001),

The Indonesian ambassador for Japan at a public lecture at the University of Bengkulu in 2014, mentioned that based on several preliminary survey of waste biomass such as midrib of palm oil tree, the Japanese government plans to establish an industry to process the midribs to produce energy in Bengkulu Province,

There is some information that is required to produce a proper planning, such as the calorific value of the biomass, economic feasibility, and a study on wood procurement, Information about the weight of midrib per unit time is needed to implement the industry, Unfortunately, until now the information is not yet available, The purpose of this study was to calculate the weight of the midribs per unit time in Bengkulu Province,

MATERIALS AND METHODS

Data area of oil palm plantations in Bengkulu Province processed to achieve the objectives of this study. The data is secondary data issued by the Statistical Office of Bengkulu province in 2014, data is retabulated to produce a communicable table (Hasan, 2002). We calculated the total amount of palm oil trees, and predicted the total weigth of their midrib (dry weight). Simanuhuruk *et al*, (2008) mentioned that one palm oil tree is estimated to produce 4 midribs / a month. They added that approximate distance between plants is 9 m x 9 m and weight of a midrib is 4.5 to 5 kg.

RESULTS AND DISCUSSION

The amount of palm midribs depend on the amount of of palm trees, Statistical Office of Bengkulu Province in 2014 published that the area of oil palm plantations in the Province of Bengkulu shown in Table 1.

The Statistical Office of Bengkulu Province divides the oil palm plantations in three categories: 1) young palm plantations (YPP); 2) fruiting palm plantations (FPP); and 3) unfruitful palm plantations (UFPP) (Table 1).

Results of the re-tabulation of the data in Table 1 is presented in talk table (Tabel 2). Table 2 shows that the area of the FPP and YPP was 195,541 ha and 70,100 ha, respectively. Midrib from the fruiting palm oil plantation (FPP) can immediately be used for the energy industry. However, for the midrib from the YPP, the farmer or the company generally does not release its midrib, The midrib can be utilized after harvesting the fruit, which is 2 to 3 years from now.

Table 2 also shows the total area from the UFPP is 2,324 ha. Actually, all part from this UFPP potentially also for the energy industry, although needed some preliminary research on the heating value and harvest costs, to make biomassa from the UFPP as raw material for the energy industry.

There are two types of dominant plantataion in the Province of Bengkulu, namely oil palm and rubber trees. Oil palm plantations are the largest plant. The total area of oil palm and rubber plantations was 267 965 ha and 129 683 ha, respectively (BDA, 2014).

As mentioned above, Simanuhuruk *et al.*, (2008) said that one palm oil tree is estimated to produce 4 midribs /month. They added that approximate distance between plants is 9 m x 9 m and weight of a midrib is 4.5 to 5 kg. Based on this information, the air dry weight of the midrib of FPP was 481,030 tons/month or 15,517,12 tons/day. The calculations were presented in Appendix 1. Using the same calculation, we found that the air dry weight of the midrib of YPP was 172,446 tons/month or 5,562,77 tons/day (Appendix 2). This means that the total midrib of palm oil plantations in Bengkulu Province was 653,476 tons /month or 21,079,88 tons /day.

The amount of midrib is very sufficient to establish an energy industry that is economically feasible. Machmud (2011) reported that a charcoal briquette industry has been economically feasible in the installed capacity of the engine 24, 3 tons per month for the product type coin and 18.2 tons per month for the product type cube. The yield of the industry is 80% or requires raw materials 53.12 tons/month.

Plans for the utilization of waste from the plantations, are supported by previous studies of the properties of the midrib as a raw material for producing energy. Wardani *et al.*, (2013) mentioned that the density of midrib is 0.5. Yakari (2008) reported that midrib consist of holocellulose, α-cellulose and lignin contents are 83.5%, 48.8% and 20.5 %, respectively. Based on the classification of chemical component and the classification of wood strength, midrib is high α-selulosa, lignin is middle and density is a second class (DirJenHut, 1976). There is a positive correlation between calorific value of the bioamass and density (Baker, 1983; Kataki and Konwer, 2002; Nasser, 2014), and holocellulose and lignin contents (Tilman, 1976; Nasser, 2014).

Based on the amount and its characteristics, the midrib of palm oil plantations is very potential as a raw material for an energy industry in Province of Bengkulu. Further investigation is needed to determine the calorific value of the midrib.

There is one advantage of the utilization of palm midrib, the energy industry does not need to pay a fee chisel to smallholders or company, because, farmers or companies have to dispose of or release the palm midrib before taking fruit (FFB). For the farmers, once they work or harvest, they can sell the fruit and palm midrib.

To strengthen the establishment plan of the energy industry in Bengkulu Province, we propose some other waste potential sources of raw materials, namely Empty Fruit Bunches (EFB) and trunks of rubber trees to be felled.

Table 1. Distribution of palm oil plantations based on regencies in Bengkulu Province in the year of 2013

Regencies	Palm plantation (State-Owned Enterprises) (Ha)		Palm plantation (private company) (Ha)		Private- palm plantation (Ha)	
Seluma	TBM	518	TBM	1,001	TBM	10,557
	TM	4,159	TM	6,375	TM	21,088
	TTM/TR	-	TTM/TR	3	TTM/TR	7
Bengkulu Utara/North Bengkulu	TBM	-	TBM	2,739	TBM	8,964
	TM	-	TM	18,139	TM	18,084
	TTM/TR	-	TTM/TR	-	TTM/TR	795
Mukomuko			TBM	8,884	TBM	26,670
	-	-	TM	31,251	TM	75,396
			TTM/TR	296	TTM/TR	1,143
Rejang Lebong					TBM	314
	-	-	-	-	TM	158
					TTM/TR	3
Kepahiang					TBM	42
	-	-	-	-	TM	60
					TTM/TR	-
Lebong					TBM	424
	-	-	-	-	TM	41
					TTM/TR	1
Bengkulu Selatan/ South Bengkulu					TBM	1,960
	-	-	-	-	TM	11,723
					TTM/TR	33
Kaur					TBM	4,184
	-	-	-	-	TM	3,776
					TTM/TR	18
Kota Bengkulu Bengkulu City					TBM	243
	-	-	-	-	TM	1,566
					TTM/TR	15
Bengkulu Tengah/ Central Bengkulu					TBM	3,600
	-	-	-	-	TM	3,725
					TTM/TR	10
Total	4,667		68,688		194,600	

Source : BDA (2014). YPP: Young palm oil plantation (palm oil that has not been fruitful); FPP: Fruiting palm oil plantation; UFPP : Unfruitful or damaged palm oil plantation.

Table 2. The distribution of oil palm plantations in Bengkulu Province

Regencies	Oil Palm Plantation (Ha)		
	YPP	FPP	UFPP
Muko-Muko	35,554	106,647	1,439
Bengkulu Utara	11,703	36,223	795
Lebong	424	41	1
Rejang Lebong	314	158	3
Kepahiang	42	60	-
Bengkulu Tengah	3,600	3,725	10
Kota Bengkulu	243	1,566	15
Seluma	12,076	31,622	10
Bengkulu Selatan	1,960	11,723	33
Kaur	4,184	3,776	18
Total	70,100	195,541	2,324

YPP : Young palm oil plantation (palm oil that has not been fruitful); FPP : Fruiting palm oil plantation;
UFPP : Unfruitful or damaged palm oil plantation

CONCLUSIONS

Source of midrib in Bengkulu Province is fruiting palm plantations (FPP) and young palm plantations (YPP). Both of them, are raw materials for the energy industry in the province of Bengkulu. The air dry weight of the midrib of FPP and YPP was 481,030 tons / month and 172,446 tons/month, respectively. This means that the total midrib of palm oil plantations in Bengkulu Province was 653,476 tons/month or 21,079,88 tons/day.

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Appendix 1. Weight calculation of the biomass of the fruiting palm oil plantation (FPP) in Bengkulu Province
Area of the FPP is 195,541 ha
Approximate distance between plants is 9 mx 9 m, then there are 123 oil palm trees / ha (10,000 m^2 / 81 m^2)
One palm tree is estimated to produce 4 midribs / a month
The weight of a midrib is 4,5 to 5 kg (Simanuhuruk *et al*., 2008)
The weight of a midrib of each month is 20 kg (four midribs X 5 kg)
The weight of the midrib per hectare per month is 2,460 kg / ha / month (123 oil palm trees x 20 kg / a month)
Total weight of the midrib is 481,030,860 kg / month (88,636 ha x 2,460 kg / ha) or 481,030tons / month or 15,517,12 tons /day

Appendix 2. Weight calculation of the biomass of the Young palm oil plantation (YPP) in Bengkulu Province
Area of the YPP is 70,100 ha
Approximate distance between plants is 9 mx 9 m, then there are 123 oil palm trees / ha (10,000 m^2 / 81 m^2)
One palm tree is estimated to produce 4 midribs / a month
The weight of a midrib is 4,5 to 5 kg (Simanuhuruk et al, 2008)
The weight of a midrib of each month is 20 kg (four midribs X 5 kg)
The weight of the midrib per hectare per month is 2,460 kg / ha / month (123 oil palm trees x 20 kg / a month)
Total weight of the midrib is 172,446,000 kg/month (70,100 ha x 2,460 kg/ha) or 172,446tons/month or 5,562,77 tons/day