Potential of biomass residues from oil palm agroindustry in Indonesia

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Abstract. Oil Palm agroindustry is growing rapidly in Southeast Asia especially Indonesia and Malaysia. Based on GAPKI data, Indonesia's CPO production 2017 is 38.17 million tons and PKO of 3.05 million tons. Production activities in palm oil agro-industry in addition to producing PKO and CPOl produce solid waste from the plantation and palm oil mill, Palm Oil Mill Effluent (POME) from the palm oil mill. The biomass waste of oil palm agro-industry comes from activities in plantations in the form of midrib, leaves and palm tree trunks. While from the palm oil mill produced solid waste in the form of palm kernel shells (PKS), mesocarp fibers (MF) and empty fruit bunches (EFB). The waste is classified as biomass residue that can be utilized so that it has added value. Biomass potential in Indonesia can be estimated from the productivity of oil palm. The volume of biomass is 5,5-8%, empty bunches 20-23%, palm fronds 13.5-15%, 15% palm fiber from 1 ton of fresh fruit bunches. The total potential of oil palm solid waste biomass in Indonesia 2017 is 20.07 million tons and POME is 23.7 million tons. The largest distribution of biomass is in Riau, North Sumatra, South Sumatra province.

1 Introduction

Oil Palm agroindustry is growing rapidly in Southeast Asia especially Indonesia and Malaysia. The oil palm plantations in Indonesia consists of smallholdings, government estate plantations and private estate plantations. The total of plantation area has increased significantly from 8.4 million hectares in 2010 to 11.26 million hectares in 2015 and is estimated to be 12.31 million hectares in 2017. Based on GAPKI data, Indonesia's CPO production 2017 is 38.17 million tons and PKO of 3.05 Million tons. It makes Indonesia the world's largest producer of palm oil. [1]

Production activities in palm oil agro-industry in addition to producing PKO and CPO produce solid waste from the plantation and palm oil mill, Palm Oil Mill Effluent (POME) from the palm oil mill. The biomass waste of oil palm agro-industry comes from activities in plantations in the form of midrib, leaves and palm tree trunks. While from the palm oil mill produced solid waste in the form of palm kernel shells (PKS), mesocarp fibers (MF) and empty fruit bunches (EFB) [2], [3], [4], [5], [6]

United Nations Framework Convention on Climate Change (UNFCCC, 2005) defined biomass is non fossil and biodegradable organic material originating from plant, animals and microorganism. This shall also include products, by product, residues and waste from agriculture, forestry and related industries as well as the non fossilized and biodegradable organic fractions of industrial and municipal waste [7]. Refer to the definition, the waste is classified as biomass residue that can be utilized.

Though biomass waste can contribute the greatest potential for supply of renewable and sustainable energy sources with abundant quantities. Because biomass is the fourth largest source of energy after coal, petroleum and natural gas. In 2010, in Sweden 14% of the energy comes from biomass, in Finland 21% of its total energy consumption comes from the forestry sector and the United States produces 9 million watt electricity from biomass. While in Germany, biomass contributes about 68.9% of the total energy as renewable energy. In Indonesia, the potential source of biomass waste from oil palm agro-industry is very large based on the existing oil palm plantation area

So it is necessary to research to determine the quantity of biomass potency of solid waste from oil palm agroindustry. The purpose of this research is to give the overview regarding the availability and distribution of the oil palm biomass wastes and potential for utilization.

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2 Materials and methods

2.1 Data collection

Data were collection through The Official publication such as Tree Crop Estate Statistics of Indonesia 2015-2017 Palm Oil [1] 2016 Handbook of Energy & Economic Statistics of Indonesia Final Edition [8].

2.2 Data analysis and calculation

Each biomass was calculated as follows :

Table 1. Calculation of Biomass.

Residues Sources	Type Residues	% weight					
FFB	PKS	5,50	5,50	7	5-7	5,5-7	5-7
	EFB	22,00	22,00	23	20-23	22-23	20-23
	Mesocarp Fiber	13,50	13,50		11-12	13.5-15	11-15
Oil Palm (froam *pemanenan*)	OPT	70,00	74,50	50	65 ton/ha	75 ton/ha	65-75 ton/ha
	OPF	20,50	14,5	20		15 ton/ha	14,5-20,5
	Leaf	6,53					
	Etc	2,97					
POME				67	50-60		
		[2]	[3]	[4]	[5]	[6]	This paper

3 Results and discussion

3.1 History of palm oil crop in Indonesia

Palm oil was imported to Indonesia by the Dutch East Indies government in 1848 from West Africa which was then planted in the Bogor Botanical Garden. When there was an increase in the demand for vegetable oils due to the industrial revolution in the mid-19th century, then came the idea of making oil palm plantations. In 1911, palm oil began to be cultivated and cultivated commercially with its pioneer in the Dutch East Indies Adrien Hallet followed by K. Schadt. The first palm oil plantations are located on the East Coast of Sumatra (Deli) and Aceh covering an area of 5,123 hectares which later increased to 32,000 Ha in 1925 and 3,400 ha in Malaysia. But in West Africa alone large-scale oil palm planting began in 1910. [9].

Statistics on oil palm crops shows that in 1970s, indonesia had only 133,298 ha of oil palm plantation. Since then, the oil palm crops area are has increased significantly as shown in fig 1. In 2017, oil palm crops area estimated 11,312 million hectares

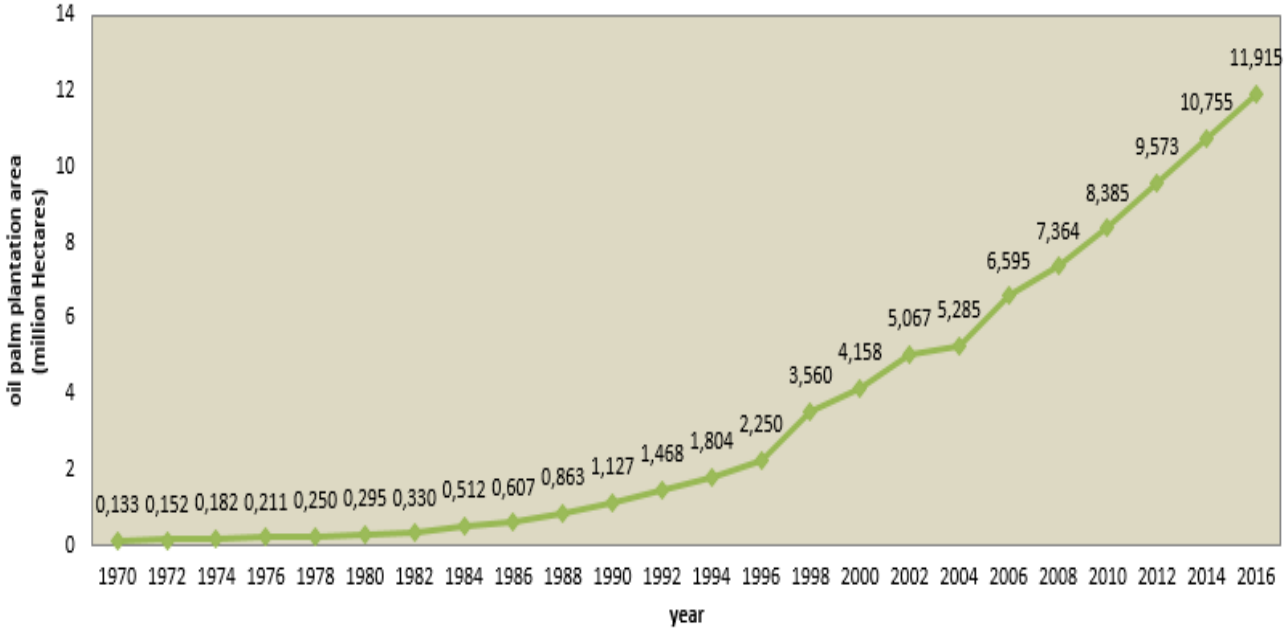

Fig. 1. Statistics on oil palm crops in Indonesia.

3.2 Distribution of palm oil crop in Indonesia

Indonesian oil production mainly come from six provinces contributed as much as 73.69% of the total palm oil production in Indonesia. The first and second ranks are Riau and North Sumatra provinces with a contribution of 23.75% and 16.24% of the total Indonesian palm oil products. Subsequent ranks of Central Kalimantan, South Sumatra, Jambi and West Kalimantan respectively contributed 10.96%, 9.76%, 6.39% and 6.60% respectively (Fig. 2)

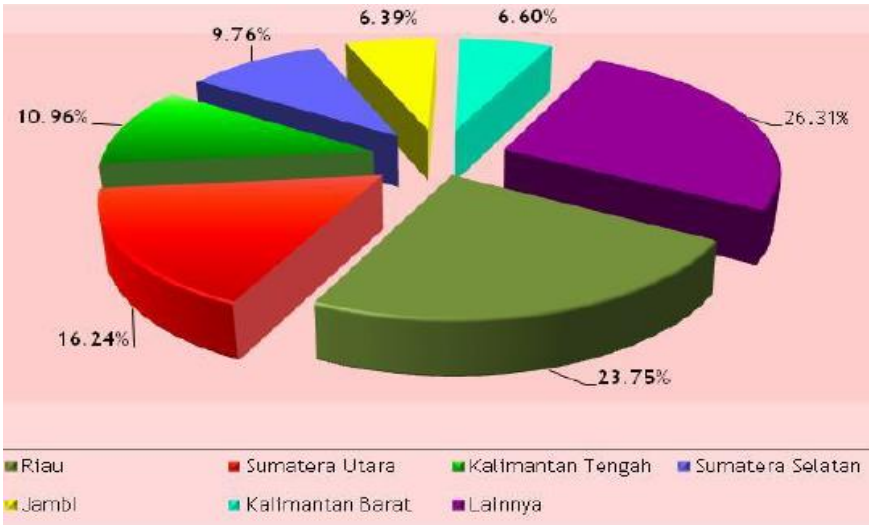

Fig. 2. Distribution of palm oil crop in Indonesia.

3.3 Availability biomass from oil palm agroindustry

In addition to producing palm oil and palm kernel oil, waste is also produced as a waste of biomass with a large percentage of components. Biomass derived from the plantation area in the form of leprosy is generated when the harvesting process coincides with the collection of TBS as well as the maintenance of each routine. While the palm tree trunks are produced at the time of replanting plants that have decreased productivity that is at the age of 25-30 years [2]. While PKS is produced by solid waste with the largest percentage of empty bunches of 20-23% of processed FFB [2], [3], [4],[5], [6] as shown in Fig. 3.

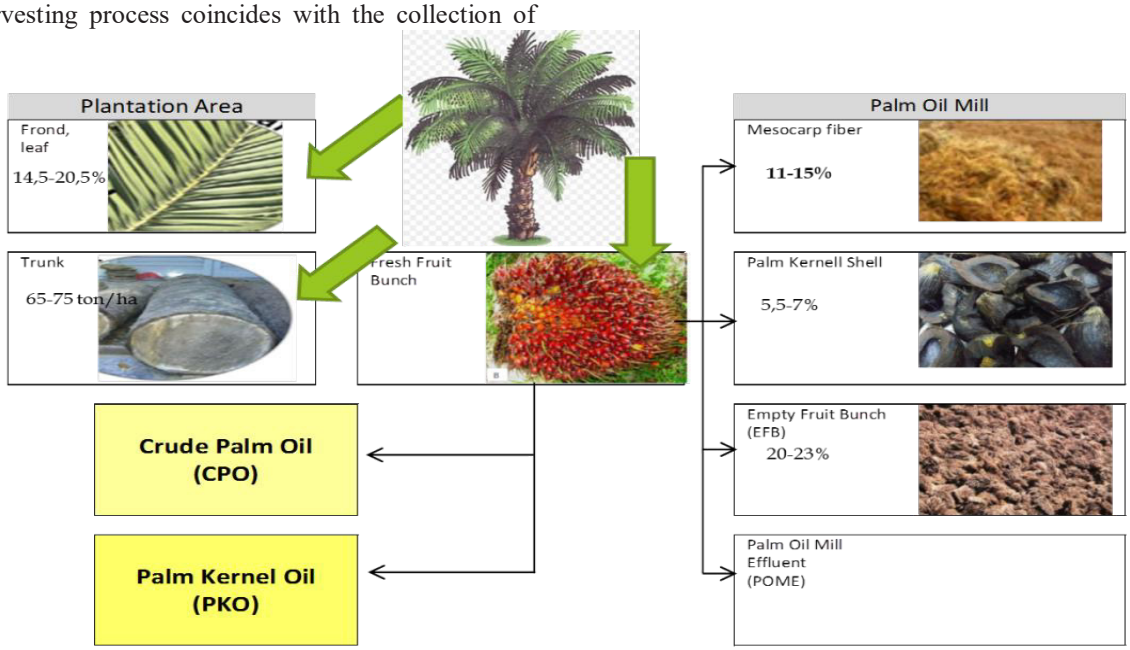

Fig. 3. PKS is produced by solid waste with the largest percentage of empty bunches of 20-23% of processed FFB.

Biomass estimates generated from oil palm agroindustry can be calculated based on these data and publications related to Indonesian oil palm statistics that contain the extent and productivity of plantation land in Indonesia. The largest oil palm solid waste biomass is in the form of empty bunches with an estimated total of more than 40 million tonnes followed by waste in the form of trunks of palm trees and midribs with volumes of more than 30 million tons. The total potential of solid waste biomass generated by oil palm plantations in Indonesia is more than 100 million tons of biomass material (Fig. 4). Biomass estimation data generated per province shows the same condition. The distribution of biomass volume is uneven because in some provinces such as Central Java, East Java, DKI, DIY, Bali, NTT, NTB, North Maluku there is no area of oil palm plantation. The amount of biomass waste is very abundant is largely not utilized to the fullest.

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Uraian	Satuan	2014	2015	2016	2017
Luas Area Perkebunan	Ha	10,754,801	11,260,277	11,914,499	12,307,677
Produksi	Ton	182,724,069	191,312,106	202,427,338	209,107,432
Produktivitas	kg/Ha	3,645	3,625	3,763	3,817
Biomassa padat					
PKS Biomass maks	Ton	12,790,685	13,391,847	14,169,914	14,637,520
PKS Biomass minimum	Ton	9,136,203	9,565,605	10,121,367	10,455,372
PKS Biomassa rata rata	Ton	10,963,444	11,478,726	12,145,640	12,546,446
EFB Biomassa maks	Ton	42,026,536	44,001,784	46,558,288	48,094,709
EFB Biomassa minimum	Ton	36,544,814	38,262,421	40,485,468	41,821,486
EFB Biomass Rata Rata	Ton	39,285,675	41,132,103	43,521,878	44,958,098
Mesocarp Biomass maks	Ton	24,667,749	25,827,134	27,327,691	28,229,503
Mesocarp Biomass minimum	Ton	20,099,648	21,044,332	22,267,007	23,001,818
Mesocarp Biomassa Rata Rata	Ton	22,383,698	23,435,733	24,797,349	25,615,660
biomass OPT min	Ton	34,953,103	36,595,900	38,722,122	39,999,950
Biomass OPT maks	Ton	40,330,504	42,226,039	44,679,371	46,153,789
OPT Rata Rata	Ton	37,641,803.50	39,410,969.50	41,700,746.50	43,076,869.50
OPF Biomassa maks	Ton	37,458,434	39,218,982	41,497,604	42,867,024
OPF Biomass minimum	Ton	26,494,990	27,740,255	29,351,964	30,320,578
OPF Biomassa Rata Rata	Ton	31,976,712	33,479,619	35,424,784	36,593,801
Total Maks Biomassa Padat	Ton	151,896,507	159,035,648	168,275,618	173,828,707
Total Mins Biomassa Padat	Ton	132,606,159	96,612,614	102,225,806	105,599,253
Total Rata-rata Biomassa Padat	Ton	142,251,333	109,526,181	115,889,651	119,714,005

Fig. 4. The total potential of solid waste biomass generated by oil palm plantations in Indonesia.

3.4 Current utilization

The biomass waste is conventionally used directly as a boiler fuel in the palm oil industry without a prior conversion process [6]. Section of waste of oil palm biomass which is exploited is shell and fiber fiber which have high calorific value as fuel for steam at industry and electricity. But the need for this industry is much lower than that of the existing biomass sources. So it continues to increase in number each year [10]. Meanwhile, empty fruit bunches that are material with high water content are stacked away in the palm oil industry area because transportation and disposal costs are expensive and ineffective. The combustion activity of fiber for boiler fuel and empty bunch disposal contributes to the negative impact on the environment [11].

4 Conclusion

Biomass from Oil Palm agroindustry is very abundance (more than 100 million ton of biomass). Its potential to convert become added value product.

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