Analysis of Supply and Demand of Coal Terminal in Sumatera

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Abstract: Indonesia is one of the largest coal producing countries in the world, with total production of 461 million tons in 2017. Based on Ministry of Energy and Mineral Resources there are three regions in Indonesia that have the largest coal reserves, namely South Kalimantan, West Kalimantan and South Sumatera. The Sumatera region holds a national coal reserve of 45%, but only 10% of the total reserves that have been managed. The demand of coal from Sumatera increased 17.40% in average during the past five years with the majority of use for power plant and exports. As a result of an increase in coal demand, the flow of cargoes at each coal terminal in Sumatera increasing, in 2017 total coal terminal troughput in Sumatera reach 28.75 million tons. This research based on secondary and primary data analysis of 5 biggest coal terminal in Sumatera, namely Panjang Port (Lampung), Bengkulu Port (Bengkulu), Jambi Port (Jambi), Teluk Bayur Port (West Sumatera), Kertapati Coal terminal (South Sumatera) and Tarahan Coal terminal (Lampung). Total coal terminal capacity in Sumatera region is 51,46 million ton / year. Based on the forecasting of coal demand in 2037 will reach 67.75 million tons, the total capacity of coal terminal in Sumatera will reach the maximum capacity of 80% in 2025 (41.70 million tons) . Coal terminal operator need to consider the port development (facilities and cargo handling equipment) to increase port capacity.

1 INTRODUCTION

Indonesia is one of the largest coal producing countries in the world, with mining points scattered in various regions and a total production of 461 million tons in 2017. Based on Ministry of Energy and Mineral Resources data there are three regions in Indonesia that have the largest coal reserves, namely South Kalimantan, West Kalimantan and South Sumatera. The Sumatera region holds a national coal reserve of 45%, but only 10% of the total reserves that have been managed (Kementerian ESDM, 2017). Based on data from the Central Bureau of Statistics, coal production in 2016 amounted to 27.56 million tons with the majority of use for power plant and exports (Petromindo, 2016).

The distribution of coal from Sumatera is generally carried out through public ports and special ports in this paper reefer as coal terminal, some of the major public ports that serve coal loading include Panjang Port in Lampung, Bengkulu Port in Bengkulu, Jambi Port in Jambi and Telur Bayur Port in West Sumatra. While the other coal are loading in special ports managed by coal mining companies include the Kertapati coal terminal in South Sumatera and Tarahan coal terminal in Lampung. The capacity of a port generally depends on the number of berths available to ship traffic and cargo handling capacity (Bugaric et.al., 2011).

Coal production and demand will affect the port sector as a provider of coal handling services. Development planning should pay attention to the increasing trend of coal as one of the main commodities. There are some conditions that will affect coal production, including coal reserves, mining business permits and mining technology.

This research aim to analyze the supply and demand side of coal terminals, the relationship between production in coal mining in each area of production mines with port operating capacity based on historical data and forecasting of future conditions. This research is expected to provide recommendations for coal terminals operator to improve the efficiency of the port by developing facilities and equipment.

2 LITERATURE REVIEW

Various research related to operations and determination of the capacity of dry bulk terminals have been carried out, Work of the ports with its optimal capacity assumes a prompt accommodation of vessels with minimal waiting time in the port and with maximal use of berth facilities. Calculation of

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port capacity related to capacity of facilities and equipments. Bert capacity use the equation below (Velsink, 2012):

$$Cb = P \times N \times n \times m \quad (1)$$

Where :
Cb = Berth Capacity (tons / year)
P = Productivity of loading / unloading tools (tons / hour)
N = Number of Gang
n = Annual Operating Time (hours)
m = BOR (%)

Equipment capacity shows the total amount of cargo that can be served by equipment:

$$KT = n \times V \times t \quad (2)$$

Where :
KT = Capacity of equipment (tons / year)
n = Number of Tools (units)
V = Tool Productivity (ton / hour)
t = Annual Operating Time (hours / years)

Stockpile capacity shows the total amount of cargo that can be stock by the area:

$$TY = (Vb \times 0.745) \times D/Dt \quad (3)$$

Where :
TY = Stacking Field Capacity (tons / year)
Vb = The volume of coal that is accommodated (m^3)
0.745 = Coal Type Mass (m^3 / ton)
D = Working Days in 1 Year (days)
Dt = Dwelling Time (days)

In other studies about the layout of dry bulk ports, it is explained that the location will affect the service of cargo loading and unloading time at the port, the distance between the berth and stockpile for example is very influential on the speed of cargo transfer (Nur et.al., 2013).

3 METHODOLOGY

In this section, the methodological framework applied in this research is presented. This research based on secondary and primary data. Secondary data is obtained from the Ministry of Energy and Mineral Resources, the Central Statistics Bureau, coal terminal operators, and other references. As for

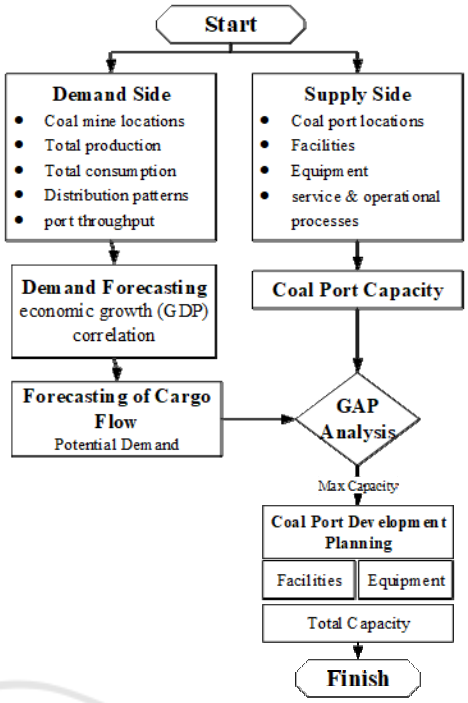

Figure 1: Research flow diagram.

the primary data obtained by surveying the operation of coal terminal activities and the handling process.

Generally, demand side analysis related to mining production as well as trends and forecastings of coal consumption. The supply side analysis is related to port coal facilities and equipment as well as coal terminal operations and services. The stages of this research consist of:

- o Demand side analysis: identification of coal mine locations, total production, total consumption, distribution patterns and port throughput;
- o Supply side analysis: identification of coal terminal locations, facilities, equipment and service operational processes;
- o Analysis of demand and supply correlation: coal demand forecastings based on demand trends and economic growth. Calculation of coal terminal capacity, to determine the maximum limit of coal services and development plans;
- o Analysis of port development plans: calculation of port development needs, including facility planning (berth and stockpile) and coal handling equipment. Development plan based on capacity requirements and coal service demand forecastings.

4 ANALYSIS AND DISCUSSION

Analysis in this research includes 6 (six) main coal terminals of Sumatra: (1) Panjang Port in Lampung, (2) Bengkulu Port in Bengkulu, (3) Jambi Port in Jambi, (4) Telur Bayur Port in West Sumatera, (5) Kertapati Port in South Sumatera and (6) Tarahan Port in Lampung (Figure 2).

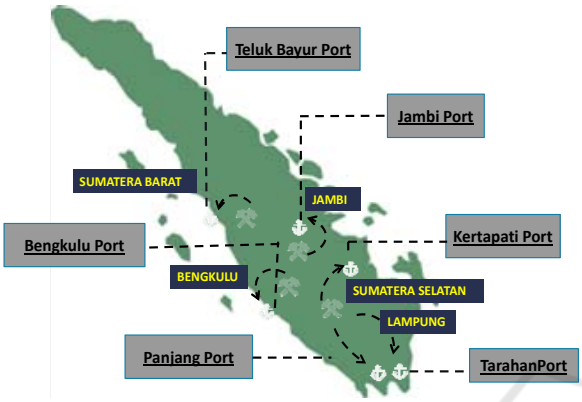

Figure 2: Six main coal terminal of Sumatera.

4.1 Analysis of Demand Side

Data on coal production in the Sumatera during the last 5 years (2013 - 2017) show on Table 1 below:

Table 1: Coal production of Sumatera.

Total in Million Ton				
Year	South Sumatera	Jambi	Bengkulu	West Sumatera
2013	23.14	7.74	6.76	1.53
2014	26.45	7.80	4.27	0.62
2015	29.79	4.87	4.54	0.42
2016	32.55	3.78	3.17	0.32
2017	35.87	5.18	4.24	0.43

The total coal production of Sumatera in 2013 was 39.17 million tons, for 2015 is 39.65 million tons and in 2017 is 45.73 million tons. The average growth of coal production is 17.40%. Distribution process coal from the mine to coal terminal using multimodal mode, such as truck and train, consumers of coal from Sumatra are majority from java.

Total coal throughput of Sumatra in 2013 is 20.56 million tons, in the year 2015 is 22.91 million tons and in 2017 is 28.25 million tons. The average growth of coal cargo flow is 3.97% (Table 2).

Table 2: Coal terminal troughput.

Coal Port	Troughput (Mil-Ton)				
	2013	2014	2015	2016	2017
Bengkulu Port	4.83	5.97	5.15	5.28	5.47
Jambi Fort	3.58	0.49	3.64	0.15	3.38
Panjang Port	3.47	0.52	3.47	0.51	3.60
Teluk Bayur Port	1.33	0.57	3.39	0.32	3.41
Kertapati Port	1.89	2.16	2.29	3.01	3.10
Tarahan Port	11.47	13.27	13.96	15.05	13.29
Total	23.56	22.98	22.91	24.33	28.25

4.2 Analysis of Supply Side

The supply side analysis is related to port coal facilities and equipment as well as coal terminal operations and services. Port capacity calculation use to determine the total amount of cargo that can be served and when a development plan is needed. The calculation of port capacity includes the calculation of the berth capacity and stockpile.

Table 3: Coal terminal capacity (berth, equipment & stockpile).

Coal Port	Port Capacity (Mil Ton)		
	Berth	Equipment	Stockpile
Bengkulu Port	8.76	8.76	8.19
Jambi Port	1.05	2.628	6.78
Panjang Port	19.27	19.272	-
Teluk Bayur Port	11.56	10.512	-
Kertapati Port	3.68	9.198	21.90
Tarahan Port	8.76	21.9	78.48
Total	53.09	72.27	115.34

Table 3 above, show coal terminal capacity in Sumatera, for berth capacity 53.09 Mil Ton/year, equipment handling capacity 72.27 Mil Ton/year and for stockpile capacity 115.34 Mil Ton/year.

4.3 Analysis of Demand and Supply Correlation

Analysis of coal demand is carried out by forecasting coal troughput of terminal, trend analysis combine with regression analysis between coal troughput and the value of Gross Domestic Regional Products (GDRP) use for the forecasting method. The equation result from the regression is $y = 0.7592x + 388775$ and $R^2 = 0.9462$ (Figure 3).

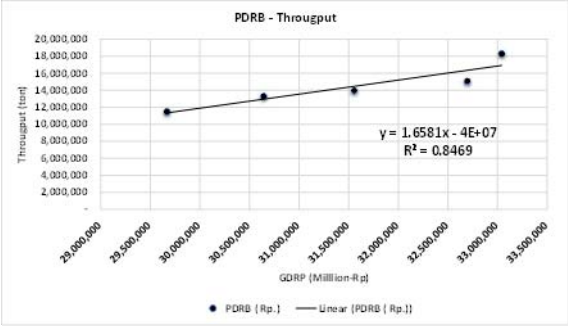

Figure 3: Regression of coal troughput & GDRP.

Based on the forecasting, coal demand from Sumatera in 2025 will reach 39.81 million tons, in 2037 will reach 65.32 million tons (Figure 4).

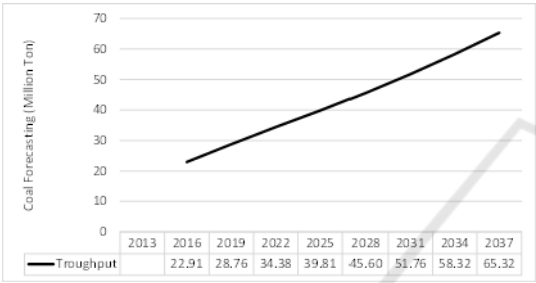

Figure 4: Coal demand forecasting (2019 – 2037).

Tarahan coal terminal with the largest coal handling proportion of 62%, forecasting coal demand through the terminal in 2037 reaches 45.95 million tons. Detail of coal forecasting of each terminal can bee seen on Table 4 below:

Table 4: Coal terminal troughput forecasting.

Year	Coa Terminal Troughput Forecasting (Million Ton)						TOTAL
	BENGKULU	JAMBI	TELUK BAYUR	PANJANG	KERTAPATI	TARAHAN	(Million ton)
2013	4.83	0.58	1.33	0.43	1.89	11.47	20.56
2014	5.07	0.49	0.57	0.52	2.16	13.27	22.98
2015	5.15	0.64	0.39	0.43	2.29	13.96	22.91
2016	5.28	0.15	0.32	0.52	3.21	15.35	24.39
2017	5.47	0.38	0.41	0.66	3.17	18.29	28.25
2018	5.47	0.55	0.72	0.63	3.32	18.11	28.76
2019	6.17	0.57	0.72	0.69	3.59	19.31	32.05
2020	6.24	0.65	0.74	0.66	3.87	22.54	32.65
2021	6.36	0.62	0.77	0.68	4.15	21.82	34.38
2022	6.49	0.65	0.79	0.72	4.44	23.28	36.15
2023	6.62	0.68	0.81	0.79	4.72	24.39	37.96
2024	6.75	0.72	0.84	0.75	5.01	25.73	39.81
2025	6.89	0.79	0.87	0.77	5.34	27.15	41.70
2026	7.03	0.76	0.89	0.85	5.66	28.48	43.63
2027	7.17	0.79	0.92	0.82	5.98	29.52	45.60
2028	7.31	0.82	0.95	0.85	6.31	31.38	47.61
2029	7.46	0.85	0.97	0.87	6.64	32.86	49.66
2030	7.61	0.88	1.00	0.90	6.98	34.38	51.76
2031	7.76	0.91	1.03	0.93	7.33	35.94	53.90
2032	7.92	0.94	1.06	0.96	7.69	37.52	56.09
2033	8.08	0.97	1.09	0.98	8.05	39.14	58.32
2034	8.24	1.01	1.12	1.01	8.42	42.80	62.61
2035	8.41	1.04	1.15	1.04	8.80	42.48	62.94
2036	8.58	1.07	1.19	1.07	9.19	44.22	65.32
2037	8.75	1.11	1.22	1.11	9.59	45.98	67.75

The total capacity of coal terminal in Sumatera will reach the maximum capacity of 80% in 2025 with the total coal demand of 41.70 million tons. Figure 5 show the relation of coal terminal capacity and coal forecasting:

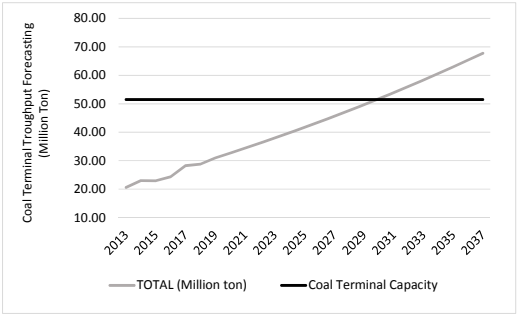

Figure 5: Coal demand forecasting and terminal capacity.

Coal terminal operator need to consider the port development, including terminal facilities and cargo handling equipment to increase port capacity. Table 5 below, show coal terminals development need to meet demand of coal handling.

Table 5: Coal terminal development.

Coal Terminal	Development	Volume	Unit	Capacity (Ton/Hour)
BENGKULU	Coal Stockpile area	4,398	m^2	-
JAMBI	Belt Conveyor	550	unit	550
TELUK BAYUR	Gantry Jib Crane	3	unit	400
KERTAPATI	Gantry Jib Crane	850	unit	850
TARAHAN	Jetty	11,060	m^2	-
	Gantry Jib Crane	3,600	unit	3,600

5 CONCLUSIONS

There are 4 (four) regions in Sumatera which have largest coal production in 2017, there are South Sumatera (35.87 million tons), Bengkulu (3.02 million tons), Jambi (5.18 million tons) and West Sumatra (0.43 million tons). Total production in 2017 reach 45.73 million tons. The average growth of coal production is 17.40% during the past five years with the majority of use for power plant and exports. The total existing capacity of coal terminal in Sumatera is 51.46 million tons, which include Bengkulu Coal Terminal (8.18 million tons), Jambi Coal Terminal (1.05 million tons), Panjang Coal Terminal (19.27 million tons), Teluk Bayur Coal Terminal (10.51 million tons), Kertapati Coal Terminal (3.68 million tons) and Tarahan Coal Terminal (8.76 million tons). Based on the forecasting of coal demand in 2037 will reach 67.75 million tons, the total capacity of coal terminal in Sumatera will reach the maximum capacity of 80%

in 2025 (41.70 million tons). Coal terminal operator need to consider the port development (facilities and cargo handling equipment) to increase port capacity.

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