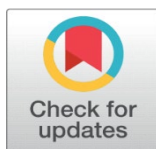# SEDIMENT ANALYSIS IN THE RIVER OF PALEMBANG CITY

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ABSTRACT

Palembang City has several watersheds (DAS), namely the Dam River, Kedukan Bukit River, Sekanak River, and Lambidaro River which are rivers in Palembang City which often experience runoff due to flooding. but there are several problems in the watershed, including the problem of river silting which results in frequent flooding in several river areas during the rainy season. In the last few years, the watershed has not been normalized.

Problems in the watershed may also have excessive sediment buildup. If there are no countermeasures, it can lead to silting of the river due to excessive sedimentation. To determine the sedimentation in the watershed, sediment samples were tested using the Duboy's method and the shield's method, the Yang'S method, the Bagnold method, and the Shen and Hung method.

The results of the discussion obtained from the results of the Qt calculation are on the Bendung river using the Duboy's method = 131.67 tons / year, Shield's method = 131.35 tons / year. Kedukan River The volume of floating sediment in the next one year is 91,517,472 m^3/s for the Duboy's method and 498,89952 m^3/s for the Shield method, and for the average of total sediment discharge value obtained from each equation, namely Yang method = 0.0091315 tons/sec, for Bagnold method = 0.0038365 tons/sec and Shen and Hung method = 0.0001495 tons/sec. The average sediment yield that occurs in the Lambidaro River in Palembang City in the next one year is 136.656 kg/year/m. The volume of sediment in the Sekanak River is 10,495.7 (lb/yr)/ft. Shield's method Average yield of qb sediment is 4,064.6 (lb/yr)/ft.

Keywords: River Palembang, Sediment, Duboy's Shield's, Yang's, Bagnold, and Shen and Hung Method

1. INTRODUCTION

Palembang City has several watersheds (DAS), namely the Dam River, Kedukan Bukit River, Sekanak River, and Lambidaro River which are rivers in Palembang City which often experience runoff due to flooding. but there are several problems in the watershed, including the problem of river silting which results in frequent flooding in several river areas during the rainy season. In the last few years, the watershed has not been normalized, so that flooding in the area may be caused by the non-functioning of the watershed.

Problems in the watershed may also have excessive sediment buildup. If there are no countermeasures, it can lead to silting of the river due to excessive

sedimentation. To determine the sedimentation in the watershed, sediment samples were tested using the Duboy's method and the shield's method, the Yang'S method, the Bagnold method, and the Shen and Hung method.

The objectives to be achieved from this research are:

1) To calculate the sediment discharge that occurs in the Bendung River, the approach is Shear Stress Approach (Duboy's Method and Shield's Method). For a period of one year ahead on Sungai Bendung.

2) To calculate the volume of floating sediment using the Shear Stress approach where there are two methods, namely the Duboy's method and the Shield Approach as well as calculating the volume of floating sediment in the next one year in the Kedukan Bukit River, Palembang City.

3) This study aims to determine the analysis and influence of river flow discharge on sedimentation in the Lambidaro River in Palembang City.

4) To calculate the volume of sediment contained in The Sekanak River using the Shear Stress approach (Duboy's Method and Shield's Method). And calculate the volume of sediment for the next one-year period on the Sekanak River.

2. LITERATURE REVIEW

Definition of River

According to Iskandar et al. (2013) Rivers are natural channels on the earth's surface that accommodate and channel rainwater from higher areas to lower and finally empties itno lakes or seas. In the water flow also transported sedimentary materials originating from the erosin process carried by the water flow and can caused silting due to sedimentation where the water flow will end up in a lake or in the sea.

River Flow

A river channel is divided into three parts. They are the upstream, the middle and the downstream.

1) Upstream

The upstream means going agains the river flow. The flow is fast and usually has a greater speed than the downstream so that during a flood, the erosion material is transported not only fine sediment particles but also sand, gravel, and even stone.

2) Middle part

When waterflow rate has decreased is called middle stream. This section is a transitional area from upstream and downstream. The slope of the riverbed is gentler so that the relative flow velocity is smaller than upstream. This section is an area of balance between erosion and sedimentation processes which vary greatly from season to season.

3) Downstream

Downstream is happened when the flow rate of the water has decreased. This situation causes some places to become flooded areas (inundation) and facilitates the formation of deposition or sediment. The deposits formed are usually in the form of fine sand deposits, mud, organic deposits, and other types of deposits that are very stable, downstream from the watershed are generally in the form of agricultural cultivation areas, residential (urban) and industrial areas, as well as reservoirs.

River morphology

River properties are strongly influenced by the area and shape of the watershed (DAS) as well as the slope of the river. The shape of the cliffs, the bottom of the estuary and the coast in front of the estuary have an influence on the formation of sedimentation, especially on sediment transport Sudarman (2011).

Aspects of river morphology including geometry (shape and size), type, nature and behavior of rivers with all aspects and changes in the dimensions of space and time. River morphology will develop either longitudinally or transversely. An activity or event in the river area will cause physical and biotic changes with a faster time than natural changes Hadmoko (2010).

Definition of Debit

Discharge is the volume of water flowing per unit time through a cross section such as rivers, pipes, spillways, aquifers and so on. Discharge data is needed to determine the volume of flow or its changes in a watershed system. Discharge data is obtained by measuring direct discharge and measuring indirect discharge, namely by calibrating meanders Soemarto (1987)

Flow rate is the rate of water flow in the form of volume of water that passes through a cross section of the river per unit time Asdak (2002). To meet the integrity of irrigation water, the water discharge must be sufficient to be channeled into the prepared canal. To calculate the flow rate, the following equation can be used:

$$Q = A \times V$$

Information :
Q = Discharge (m^3/s)
A = Channel Cross-sectional Area (m^2)
V = Flow Speed (m/s)

Definition of Sediment

Sediment is fragments of material generally consisting of rock descriptions physically and chemically. Sedimentation can be defined as coagulation, floating or settling of material by water. These particles range in size from large (boulder) to very fine (colloidal), and vary in shape from round, oval to square. In general, particles that move by rolling, sliding and jumping are called bed-load transports, while particles that float are called suspended load transports. Sedimentary material is quartz, once the sediment particles are released they will be transported by gravity, wind and/or water Anasiru (2006).

Final deposition or sediment that occurs in relatively flat foothills, rivers, and reservoirs. In the watershed, the particles in the surface runoff will flow into the river, causing siltation of the place.

Process of Sedimentation

Sedimentation process includes the process of erosion, transportation, deposition .The process is very complex, starting ofrom the fall of rain which produces kinetic energy which is the beginning of th erosion process. Once the soil

becomes fine particles, then rolls along with the flow, some will be left on the ground while some will enter the river carried by the flow as sediment transport.

This sedimentation or deposition process takes a long time to produce something new, for example to form new rock. The type of rock that will be formed through this sedimentation process is called sedimentary rock. Then this sedimentary rock will have many examples that differ between the deposition of one material with other materials. Sedimentation is a depositional process that involves

The number of sedimentation deposits resulting from erosion indicates a high sedimentation rate. As a result of the sedimentation process is the emergence of siltation in rivers, lakes, and reservoirs. Furthermore, all the results of weathering of the material deposited through the sedimentation process will eventually become sedimentary rock.

This sedimentation process can occur due to rocks of various forces, such as the strength of the flow of water, the strength of the wind or the strength of ice or glister.

Sediment Transport

According to Mulyanto (2007), three kinds of sediment transport, namely:

1) Wash load or rinse load is the transportation of fine particles in the form of clay (silk) and dust.
2) Suspended load or floating sediment load consisting of fine sand and moving in a drift in the flow. The influence of this sediment on the river's properties is not that great, but if there is a change in the velocity of the flow this type can turn into a third type of transport.
3) Bed load or basic sediment load is a large grain of material moving on the riverbed by shifting, rolling or jumping.

The river is said to be in a balanced state if the incoming sediment capacity (Qin) in a longitudinal cross section of the river is equal to the outgoing sediment capacity (Qout) in a certain time unit. Sa'ud (2008) The process of deposition in the river occurs when the amount of incoming sediment exceeds the capacity sediment is balanced in a certain unit of time while the erosion process in the river occurs when the amount of incoming sediment is less than the balanced sediment capacity in a certain time unit. Pratama et al. (2019)

Figure 1
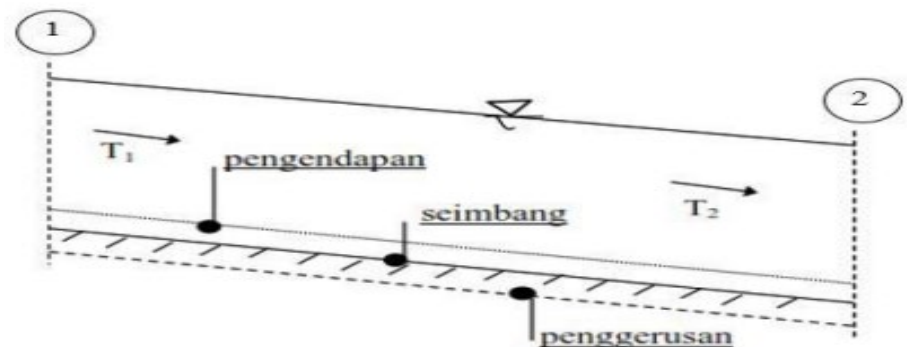
Figure 1

Sediment Movement Mechanism

Basically, sediment grains move in the carrier medium, either in the form of liquid or air, in 3 different ways: rolling, bouncing, and suspension.
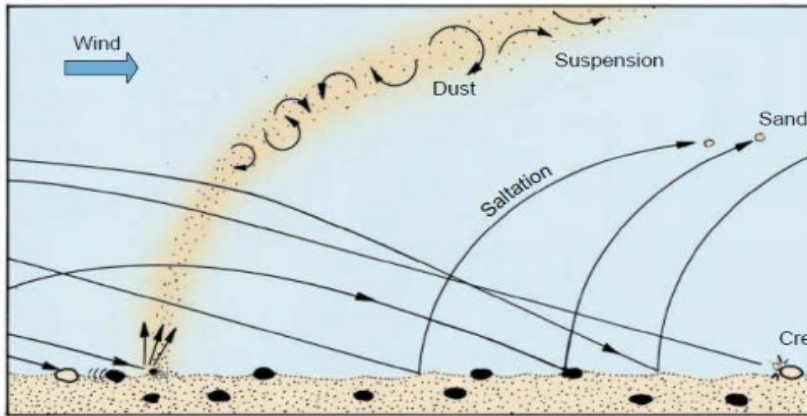
Figure 2

Figure 2

Several methods for calculating sediment volume, namely:

1) Duboy's . Method

The measurement of sediment transport using the Duboy's method is by the following equation:

$$q^b = \frac{0,173}{d^{0,75}} \tau(\tau - \tau c) = (ft^3/s) \tag{1}$$

2) Shield's Method

The measurement of sediment transport using the Shield Aproach method is by the following equation:

$$\frac{qb\ \gamma s}{q \gamma S} = 10\ \frac{\tau - \tau c}{(\gamma s - \gamma)d} \tag{2}$$

3) Yang's . Method

Which defines the flow state such as velocity, slope product, as the basis of the unit weight of water. To determine the total sediment concentration, Yang considered a relevant relationship between the following variables:

$$\text{Log Ct} = 5.435 - 0.268\text{Log}\frac{\omega d}{v} - 0.457\text{Log} + \text{Log}\frac{U*}{} \left\{ 1,799 - 0,409\text{Log}\frac{\omega d}{v}\ 0,314\ \text{Log}\ \frac{U*}{\omega} \right\} \left\{ \frac{vs}{\omega} - \frac{Vcr}{\omega} \right\} \tag{3}$$

4) Bagnold's Method

Bagnold (1966) developed the function and formula of its sediment transport based on the concept of power. He considered the relationship between the average energy available in the flow system and the average work that had been worked

together on the system during the sediment transport process. This relationship is manifested in the equation:

$$qt = V\frac{\gamma}{\gamma s - \gamma}\left\{\frac{eb}{\tan\alpha} + 0,01 \frac{V}{\omega}\right\} \tag{4}$$

5) Shen and Hung Method

Shen and Hung (1971) assumed that sediment transport wa so complex that instead of using The Reynold number,this combined Froude number could be found to explain sediment transport under all conditions. Shen & Hung tried to find the dominant variable that dominates the sediment transport rate, they recommended a regression equation based on 587 sets of laboratory data. The Shen and Hung equations can be written as follows:

$$\text{Log } Ct = -107404,45938164 + 324214,74734085Y - 326309,58908739Y^2 + 109503,87232539\,Y^3 \tag{5}$$

3. RESEARCH METHODOLOGY

Research data

1) Primary Data: to obtain primary data, the field is carried out directly which is a review of the location object, where this object review includes general data collection at the location, measurement of water level, measurement of dimensions and cross-sectional area, sediment sampling, and measurement of flow velocity.
2) Secondary Data: The secondary data is taken from related agencies such as BBWSS VIII which includes location maps and river identity data.

Data analysis

After all the necessary data has been collected, it is followed by processing the data to analyze the data using a predetermined approach. In this case study, the data will be analyzed to find the value of qb and will then analyze the volume of sediment for the next one year. By method: *Duboy's, Shield's, Yang, Bagnold and Shen and Hung*

4. RESULTS AND DISCUSSION

Based on the results of the calculation analysis obtained the following results:

Table 1

Table 1 Recapitulation of Calculation Results of Qt per year on the Bendung river.				
Section	Metode	Metode	Metode	Metode
	Duboy's	Shields's	duboy's	Shields's
	(Ton/det)	(ton/det)	(ton/thn)	(ton/thn)
1	0.93911	0.94138	81.14	81.34
2	1.29397	1.29332	111.8	111.74
3	2.33981	2.326148	202.16	200.98
Jumlah	4.57289	4.560848	395.1	394.06
Rata-rata	1.524297	1.520283	131.7	131.353333

Table 2

No.	Variabel	Hasil	Duboy's	Shield
	Table 2 Recapitulation of Qd Calculation Results on the Kedukan Bukit River.			
1	Kecepatan Aliran	0.287 m/s		
2	Luas Penampang	14.801 m²		
3	Debit Aliran	4.247 m³/s		
4	Angkutan sedimen		2.902 m³/s	1.582x10-s m³/s

Table 3

Lokasi	Metode	Metode	Metode
	Table 3 Recapitulation of Qt Calculation Results per year on the Kedukan River.		
	yang	Bagnold	shen and hung
	(ton/s)	(ton/s)	(ton/s)
Layang	0,0221986	0,0039566	0,0001687
Titik 1	0,0046215	0,0039087	0,0001844
Titik 2	0,0045142	0,0041698	0,0001085
Titik 3	0,0051918	0,0033109	0,0001363
rata-rata	0,0091315	0,0038365	0,0001495
	(ton/tahun)	(ton/bulan)	(ton/bulan)
Rata-rata	23.668,902	9.944,184	387,483
	(ton/tahun)	(ton/bulan)	(ton/bulan)
Rata-rata	287.971,640	120.987,578	4.714,375

Table 4

No.	Variabel	Titik 1	Titik 2	Titik 3
	Table 4 Recapitulation of Qd Calculation Results on the Lambidaro River			
1	Debit air (m³/dt)	0.84	0.41	0.52
2	Luas Penampang(m²)	0.22	0.17	0.25
3	Kecepatan Aliran(m/d)	3.852	2.114	2.467
4	Angkutan sedimen	0.000006	0.000003	0.000004
	(kg/dt/m)			

Table 5

Metode yang digunakan	pengerukan sedimen untuk 1 tahun lb/thn)/ft	rata-rata qb (lb/s) ft
	Table 5 Recapitulation of Qt Calculation Results per year on the Sekanak River.	
Duboy's	10.495,7	322.59
Shield's	4.064.6	128.8

5. CONCLUSION

According to result and analysis data, we may conclude:

1) In calculating the sediment load in the Bendung river for the next one-year period, the value of sediment transport generated using the Duboy's method =131.67ton/yr, Shield's method =131.35tons/yr.

2) The calculation results for the volume of floating sediment in the Kedukan river using the Duboy's method is 2,902 m^3/s, while using the Shield method the floating sediment volume is 1,582 × 10m^3/s. So that the volume of floating sediment in the next year is 91,517,472 m^3/s for the Duboy's method and 498.89952 m^3/s for the Shield method.

3) The total sediment transport discharge in the Sekanak riverr 0.0091315 ton/sec for Yang method, for the Bagnold method = 0.0038365 tons/sec and for the Shen and Hung method = 0.0001495 tons/sec.

4) By calculating using the shield method, the average sediment results that occur in the Lambidaro River in Palembang City in the next one year is equal to136.656 kg/yr/m

5) Based on the result of the analysis of calculation and recapitulation in the Sekanak River, it can be concluded that by using 2 approaches, the results for calculating the volume of sediment in the Sekanak River are the Duboy's Method. The average qb sediment yield is 322.59 (lb/s)/ft, Volume is 10,495, 7 (lb/yr)/ft. Shield's Method Average yield of qb sediment is 128.8 (lb/s)/ft, Volume is 4,064.6 (lb/yr)/ft.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

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