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RESEARCH ARTICLE

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THE EFFECT OF DEBRIC FLOW ON SEDIMENT CONTROL BUILDINGS IN JENEBERANG RIVER

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ABSTRACT

The Bili-Bili Reservoir, which is one of the largest reservoirs in South Sulawesi Province, is located in the middle of the Jeneberang watershed and was inaugurated in 1999. This reservoir is a multipurpose reservoir built with the purpose of flood control, fulfillment of irrigation water needs, raw water supply and hydroelectric power plant. The Bili-Bili multipurpose reservoir was built with the intention of controlling damaged power, optimizing the management and utilization of water resources in the upper reaches of the Jeneberang Das. However, in the latest developments there has been a decline in utilization of the reservoir service function due to changes in reservoir conditions due to erosion due to changes in land use (Tangkaisari, R. 1987) and also the caldera wall avalanche in 2004 which was upstream of Das Jeneberang (LPM UNHAS. 2004). The sedimentation prevention process cannot be carried out as there is still water flowing in the river, but the sedimentation process can be slowed down. To soften the sedimentation process, data is needed regarding the type of sediment produced and the method of transportation, location, volume, intensity of evolution of the riverbed, rain, river discharge and so on. One effort to slow down the sedimentation process is by building sediment control buildings. Sediment control buildings function to slow down movement and gradually reduce the volume of sediment. Existing sediment control buildings need to be evaluated to determine whether sediment is still capable or not, because over time and the high intensity of rainfall is one of the causes of sedimentation.

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INTRODUCTION

The Bili-Bili Reservoir is one of the largest reservoirs in South Sulawesi Province located in the central part of the Jeneberang Watershed. It was officially inaugurated in 1999. This reservoir is a multipurpose reservoir built with the purpose of flood control, fulfillment of irrigation water needs, raw water supply and generating hydroelectric power. The Bili-Bili Reservoir has a catchment area of 384.4 km2 with a planned 50-year operating life (JRBDP, 2004). In 2004 there was a landslide in the upper reaches of the Jeneberang River precisely at the foot of Mount Bawakaraeng which caused considerable sedimentation, especially in the Bili-Bili Dam. The amount of sediment until 2008 was 60,959,000 m3. When compared to the landslide in 2001, the sedimentation volume of the Bili-Bili Dam was only about 8,376,000 m3. In 2018 landslides occurred again, namely in Malino Sub-District, TinggiMoncong, the cause of which was the result of excavation of land for the construction of residents' houses without taking into account the impact caused.

Due to long-term rainfall with high intensity, landslides that occur in mountainous areas can cause mountainous material to flow towards the river. The large speed and volume of material is destructive to whatever the flow goes through. Therefore, to prevent the damage caused by sedimentation from worsening, in 2006 the Ministry of Public Works of the Directorate General of Water Resources, in this case the Sediment Control Policy Making Officer, Bawakaraeng carried out the construction of DAM Consolidation on the Jeneberang River. From the survey results of increasing sediment percentage in the Sediment Control building developed rapidly, in one return period the rain caused the sediment storage to be fully filled. The condition of the two buildings was also damaged because the volume of the reservoir is no longer effective. Therefore, the author tries to review the performance of the Sediment Controller and how to minimize the damage that occurs in the sediment control building and provide a solution to review the building by testing the sediment control building model in the laboratory. The purpose of this study is to analyze the effect of debris flow velocity on Sediment Control buildings in the upper Jeneberangriver.

MATERIALS AND METHODS

Research location at the Red Dahara Bridge and Majannang village, Kec. Tinggimoncong and Parigi sub-district Kab. Gowa. The distance of the research location from Makassar is ± 70 km. This river flows from the eastern part of Mount Bawakaraeng (2,883 masl) and Mount Lampobatang (2,876 masl) Geographically, the Jeneberang River Basin is located at 1190 23 '500 BT - 1190 56' 100 BT - 050 10 '000 LS - 050 26' 000 with the main river length 78.75 km. The Jeneberang River Basin is fed by a supporting river (tributary), namely the Jenelatariver (220 km2). Big cities covered by this Watershed besides Makassar (Ujung Pandang), namely City.

Data

This research method is a descriptive evaluative method. This research is an evaluation of sediment control buildings on the influence of land use in the upper Jeneberangriver. This study uses 2 (two) data sources including:

a. **Primary data:** Primary data is sedimentary data sourced from the Sediment Control building in the upper Jeneberangriver and flowrate data. The data intended are sediment data. Flow rate and flow rate.

b. **Secondary Data"** The required data include sedimentary data of the Bawakaraeng Caldera. This data is used to determine the amount of sediment that is still accommodated in the upper reaches of the Jeneberang River due to the landslide of the Bawakaraeng Caldera in 2004 - 2016.

Materials: Before conducting the research, preparatory work is carried out beforehand which includes taking sand material in the field then testing the sand material at the laboratory. Measure flow velocity and river dimensions. Observe the condition of the Consolid Dam building. The data needed in this study are situation maps, topographic maps, rainfall data, sediment data and Consolidation Dam building planning data (CD 1-1, CD 1-2, CD 1-3, and CD 1-4)

RESULTS

Analysis of Sediment Characteristics: Sedimentation volume in buildings controlling sediments is remarkable because in one rainy period the volume of storage of the building of SABO DAM is fully filled. The sedimentation rate can be calculated based on the volume of sediment from the measurement results. But the measurement data obtained is that after the Consolidation DAM CD.1-1 building was completed, while for the data prior to the building because there were no measurements, it was approached with the plan's sedimentation rate. This test uses samples that have been taken directly from the research location in the Consolitation CD 1-1 building on the Jeneberang River, then laboratory testing.

Analysis of Sediment Concentration: Based on the experimental results and the equation of calculation of sediment concentration (Cs), can be seen in Table 1.

Analysis of Sediment Weight: For calculation of Sediment Specific Gravity (Gs) can be seen in Table 3. From the value of the specific gravity it was found that the sediment contained in the Consolidation CD 1-1 building consisted of silt sand.

Table 1. Results of Sediment Concentration

Number	information	I (gram)	II (gram)
1	Wet sample weight	100	100
2	Dry sample weight	95	93
3	Water weight	5	7
4	Weight of sample after washing	94	91
5	Weight of sludge	1	2
6	Sediment concentration	0,17	0,22
	average	0,19	

Table 3. Test Results for Sediment Species Weight

Trial Number	I	II
Piknometer weight, W_1 (gr)	45,00	46,00
Piknometer weight + air, W_2 (gr)	142,10	144,20
Piknometer weight + air + tanah, W_3 (gr)	158,2	159,6
Dry soil weight, W_s (gr)	25,00	25,00
Temperature, ^{0}C	28	28
Correction factor, α	0,9927	0,9927
Specific gravity Gs	2,79	2,59
Specific Gravity Rate, Gs	**2,69**	

Table 4. Sieve Analysis Test Results

Filters No.	Diameter (mm)	Material Weight Restrained (gr)	Cumulative Weight (gr)	Persen (%)	
				bated	Losses
4	4,75	0	0	0	100
10	2	38	38	7,6	92,4
18	0,84	70	108	21,6	78,4
40	0,425	178	286	57,2	42,8
60	0,25	175	461	92,2	7,8
100	0,15	31	492	98,4	1,6
200	0,075	8	500	100	0
Pan	-	0	500	100	0

Analysis of sediment diameter: Filter analysis carried out in the laboratory, from the results of experiments obtained the grain diameter or gradation coefficient of the sediment. The uniform diameter value (d50) obtained is = 0.5089 mm. Based on Fig.2 the results of the screening analysis test showed that all sediment samples escaped in filter No. 4 (4.75 mm), while the grain diameter of the sediments that escaped was about 50% in the no. 18 (0.84 mm). and the percent value passed = 0 is in the no. 200 (0.075 mm).

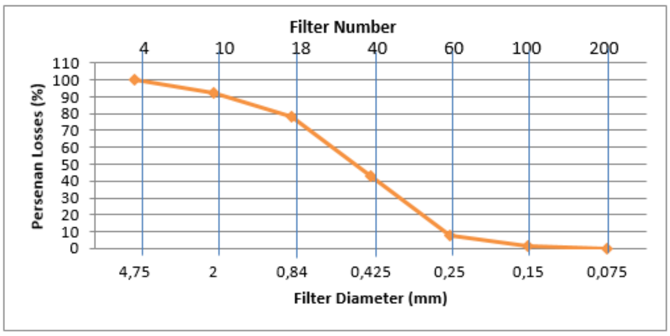

Fig. 2. Filter Analysis Graph

Based on the diameter of the sediment above, this sediment can be clarified as a medium type sediment because of its size between 0.2 mm to 0.6 mm.

Analysis of Debit Sediment

Calculation of Cross Section (A)

Table 4. Analysis of Area of Section (A)

Location	Lebar (L) (m)	Heihgt(H) (m)		
		H_1	H_2	H_3
1	67,65m	0,67	0,75	0,63
2	48,40	0,23	0,45	0,56
3	54,96	0,36	0,42	0,39
Total	171,01	Σ (H)		4,46
Average	57,003	Average		0,49

Flow Velocity Analysis (V): Channel length / measurement path (P) = 50 meters (path length must be fixed).

Table 5. Flow Velocity Analysis

Location	Time (s)
1	14,70
2	24,35
3	29,93
Total	68,98
Average	22,99

Flow velocity (v) is the result of the division between channel length / flow (P) divided by the average time (T average).

$$V = \frac{P}{T_{rata-rata}}$$

$$V = 2{,}17\ {}^{m}/_{s}$$

Analysis Debit Flow: Debit flow (Q) is the product of the multiplication of the cross-sectional area (A) of the channel / flow with the f;owvelocity (V) of the water flow.

$$Q = A \times V$$

$$Q = 60{,}61\ {}^{\mathrm{m}^3}/_{s}$$

Analysis of Sedimentation Rate

Analysis of the amount of daily sediment discharge according to Suripin (2002, attached) is calculated by the formula:

Qs = 0.0864 Cs Qw

Qsm= 0.0864 × Cs ×Qw

= $0{,}13{}^{t}/_{years}$

Qsd= 65 % × 0,13

= $0{,}0845{}^{ton}/_{years}$

Q,total =0,13 + 0,0845

= $0{,}2145{}^{ton}/_{years}$

Analysis Sediment Volume: Based on the data, BBWS PompenganJeneberang calculates the Sabo DAM storage volume based on contour lines, starting from the bottom contour line on the Consolidation DAM CD.1-1 + .EL 539,282 to the top contour on the Consolidation DAM CD.2 + .EL 697,000 building which becomes water storage in normal and flood conditions. With contour lines in the form of closed polygons, with Cad software the area can be calculated. If there are islands or bumps, the area is reduced by the area of the contour with the same elevation from the island or mound. Based on the elevation list and area, the volume of space can be calculated using the triangle prism formula as follows.

$$LA = {}^{1}/_{2} \times a \times t$$

$$LA = 291{,}9\ m^2$$

And for the volume of sediment storage in the CD 1-1 Consolidation DAM buildings are:

$$V = LA \times T_{prisma}$$

$$V = 99.246\ m^3$$

the sediment storage volume capacity in the CD 1-1 Consolidation DAM building is 99,246 m3.

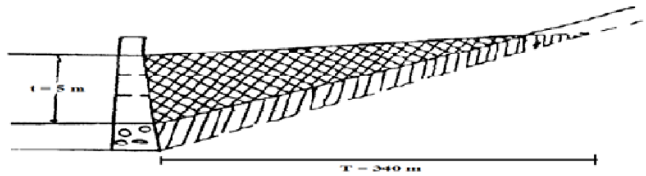

Fig. 3. The Storage Volume on the Consolidation DAM CD 1-1

Conclusion

The based on the results of the study for the analysis of sedimentation rates in Sediment Control buildings on the Jeneberang River, there was an increase in speed so that the increase in sediment was still high even though there were already several buildings before the Consolidation Dam CD 1-1. And the volume of sediment storage in the Consolidation Dam CD 1-1 building is still in safe condition with a percentage of 15%.

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