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The Effect of Climate Changes on Sediment Concentration in the Saddang Irrigation Area

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Abstract. Saddang irrigation area does not get water evenly this is due to, among other things, the condition of the network experiencing a decrease in capacity. The decrease in capacity was caused by sedimentation at the bottom of the channel and the condition of the channel lining was damaged, resulting in seepage/leakage and the building and sluice gates were not functioning properly. This study aims to analyze seasonal changes to sediment concentrations in the main channel Rappang Pinrang Regency. This research was conducted in the Rappang main channel, Pinrang Regency with the coordinates of 3°41'44.93"S 119°40'43.12"E. Data collection was divided into 3 research locations, namely the upstream, middle and downstream of the Rappang main channel with a distance of ± 33 km from upstream to downstream. Sediment sample testing was carried out at the Civil Engineering Soil Mechanics Laboratory, Hasanuddin University, Makassar. Data collection in the form of flow velocity, suspended load and flow rate was carried out in the upstream, middle and downstream areas of the Rappang main channel. The expected result of this study is to find the value of the effect of seasonal changes on sediment concentration in the Rappang Pinrang Regency.

Keywords: Rappang Main Channel, Sediment Concentration, Pinrang Regency.

1. Introduction

In the saddang river, it can be seen that there have been fluctuations in floating sediment in recent years which can be seen that the sediment transport activity in the middle is higher than the upstream and downstream rivers, this can be caused by erosion in the upstream river which causes degradation so that it carries large amounts of sediment transport. to the middle of the river then in the middle area of the river there is deposition and aggradation occurs so that for several years it can be seen when it reaches the downstream the sediment transport activity decreases and by using the empirical formula of Meyer Peter Muller the results of the analysis of the last few years in the upstream and downstream of the Saddang river there is a sediment transport process different drift rates, namely floating sediment discharge (Q_s) upstream of 104,204 kg/day or 0.104 tons/day, in the middle of 1347,473 kg/day or 1,347 tons/day and downstream of 2128,906 kg/day or 2,128 tons/day [1] Saddang River in the rainy season with river water the water turns cloudy, and along the downstream of the Saddang river there are sediment deposits that cause siltation so that the ability of the river to drain water is getting smaller. sediment concentration (C_s), the estimated floating sediment is 93,389,256 tons/year and bottom sediment is 18,677,851 tons/year (Nurhidayah Basri, 2019) The decrease in capacity is caused by sedimentation at the bottom of the channel and the condition of the channel lining is damaged, so that seepage/leakage occurs and buildings and sluice gates are not functioning properly.



2. Method and Material

2.1 Research Location and time

This research is an experimental in the field and was carried out in November 2021 and May 2022. This research was carried out on the Upstream to Downstream Rappang Main Channel. The distance between the Upstream to Downstream of the Rappang Main Channel is +- 33 Km. The distance between the upstream to the middle of the research point is +- 18 Km, while the distance between the middle to the downstream channel is +- 15 Km by examining the flow velocity and sediment drift in the Rappang primary channel. The research sample was tested at the Soil Mechanics Laboratory, Department of Civil Engineering, Faculty of Engineering, Hasanuddin University, Gowa.



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Figure 1. Research Location

2.2 Data Collection Technique

To obtain data as the main material in this study, two methods of data collection were used, namely:

1. Literature study, to obtain secondary data by reading a number of books, scientific articles as a theoretical basis for the perfection of this research.
2. Secondary data collection consisting of:
 - a. Rainfall data collection at Benteng Rain Station and Mallaga Rain Station
 - b. Discharge data from the Rappang DI Saddang main channel in 2010 - 2021.
 - c. Rappang main line Existing Data

3. Primary data collection by:

Primary data collection was carried out through field surveys to observe field conditions in detail about the condition of the Rappang main canal. In addition, primary data collection was also carried out by measuring the flow velocity in the channel and taking *suspended load* samples from the primary channel in Saddang Irrigation Area.

a. Measurement of flow velocity in the Rappang Mains channel using a *Current Meter Model Propeller A. OTT. measuring instrument*

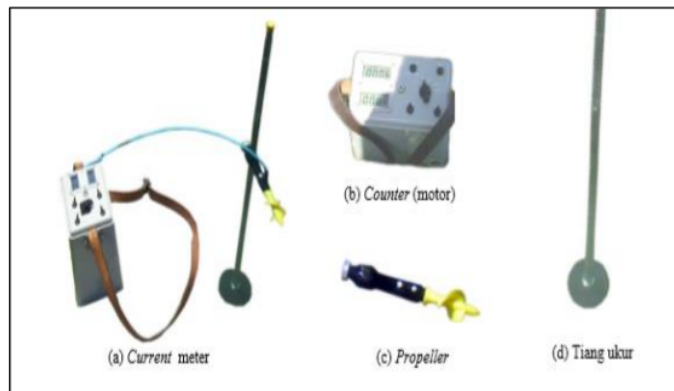


Figure 2 . Current Meter Propeller A. OTT

The measurement procedure using a current meter is as follows:

1. Measure the depth of the channel with the measuring rod of the current meter tool
 2. Choose a propeller that is suitable for the channel depth, so that it can be used for several vertical points, namely $0.2h$, $0.6h$, and $0.8h$ where h is the channel depth
 3. The current meter is mounted on a measuring pole (static) with a depth of $0.2h$, $0.6h$, and $0.8h$, then the measuring pole is immersed in the water until the measuring pole is located at the bottom of the channel with the propeller facing the direction of flow.
 4. The number of revolutions per unit time, which occurs at each water depth is calculated.
- b. Sampling of floating sediment in the Rappang main channel using the *Van Dorn Bottle Samplers tool*.



Figure 3 . Van Dorn Bottle Samplers

The procedure for taking floating sediment samples using Van Dom Bottle Samplers is :

1. The fishing line of the two tube covers is attached to the hook and clamped with the hook clamp.
2. After the tube cover is open, the tool is lowered to the desired depth by using a tube hanging rope with an additional iron pole as a support.
3. When Van Dom has been in the desired position, the metal clamp opening is dropped to open the clamp so that the rubber connecting the cover can function to close the tube that already contains the desired water sample.
4. After that Van Dom was ready to be picked up again.

2.3 Research Data Collection

Table 1 shows a matrix of research variables in the Rappang trunk. Each research location is divided into 5 segments of the channel width by taking data on flow velocity, floating sediment and bottom sediment at each location.

Table 1 . Research data retrieval matrix.

No	Research sites	Examined variables	
		Velocity	Suspended Load
1	Upstream	8	
	Segment 4	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 2	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 3	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 4	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 5	0.2H, 0.6H & 0.8H	0.6 of Depth
2	Middle	1	
	Segment 4	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 2	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 3	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 4	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 5	0.2H, 0.6H & 0.8H	0.6 of Depth
3	Downstream	1	
	Segment 4	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 2	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 3	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 4	0.2H, 0.6H & 0.8H	0.6 of Depth
	Segment 5	0.2H, 0.6H & 0.8H	0.6 of Depth

2.4 Sediment Sample Test

Sediment sample testing was carried out in the soil mechanics laboratory by testing suspended load sediment samples in November 2021 and May 2022 from upstream, middle and downstream of the Rappang Kab. Pinrang. The data that will be obtained in testing the suspended sediment sample is the sediment concentration.

3. Result and Discussion

Table 2. Flow Velocity and Sediment Concentration at Upstream Rappang Main Channel in November 2021

Upstream	Depth (H)	Vertical Point	Depth (m)	Velocity V(m/s)	V Average	Cs (mg/l)
T1	2.2	0.2	1.76	0.143	0.130	320
		0.6	0.88	0.127		
		0.8	0.44	0.120		
T2	2.2	0.2	1.76	0.145	0.138	310
		0.6	0.88	0.141		
		0.8	0.44	0.129		
T3	2.5	0.2	2.00	0.161	0.150	300
		0.6	1.00	0.154		
		0.8	0.50	0.135		
T4	2	0.2	1.60	0.147	0.136	330
		0.6	0.80	0.139		
		0.8	0.40	0.123		
T5	1.85	0.2	1.48	0.143	0.128	340
		0.6	0.74	0.125		
		0.8	0.37	0.116		

In Table 2 the highest average velocity upstream of the Rappang main channel in November 2021 is located at T3 at a depth of 2.5 m with an average velocity of 0.150 m² /s with a sediment concentration value of 300 mg/l and the smallest velocity at T5 at a depth of 1.85 m with velocity of 0.128 m² /s with a sediment concentration value of 340 mg/l.

Table 3. Flow Rate and Sediment Concentration in the Middle of the Rappang Main Channel in November 2021

Middle	Depth (H)	Vertical Point	Depth (m)	Velocity V(m/s)	V Average	Cs (mg/l)
T1	1.58	0.2	1,264	0.138	0.126	200
		0.6	0.632	0.123		
		0.8	0.316	0.117		
T2	1.9	0.2	1.52	0.142	0.135	200
		0.6	0.76	0.136		
		0.8	0.38	0.126		
T3	2.05	0.2	1.56	0.157	0.145	180
		0.6	0.78	0.151		
		0.8	0.39	0.127		
T4	1.95	0.2	1.64	0.135	0.130	230
		0.6	0.82	0.133		
		0.8	0.41	0.122		
T5	1.4	0.2	1.12	0.135	0.123	240
		0.6	0.56	0.119		
		0.8	0.28	0.116		

In Table 3 the highest average velocity in the middle of the rapping main channel in November 2021 is located at T3 at a depth of 1.9 m with an average velocity of 0.145 m²/s with a sediment concentration value of 180 mg/l and the smallest velocity at T5 at a depth of 1.4 m at a speed of 0.123 m²/s with a sediment concentration value of 240 mg/l.

Table 4. Flow Rate and Sediment Concentration at the Rapping Main Channel Downstream in November 2021

Downsteam	Depth (H)	Vertical Point	Depth (m)	Velocity V(m/s)	V Average	Cs (mg/l)
T1	1.7	0.2	1.36	0.133	0.121	100
		0.6	0.68	0.116		
		0.8	0.34	0.113		
T2	2	0.2	1.60	0.138	0.130	90
		0.6	0.80	0.133		
		0.8	0.40	0.119		
T3	2.2	0.2	1.76	0.149	0.139	80
		0.6	0.88	0.143		
		0.8	0.44	0.123		
T4	2	0.2	1.60	0.129	0.124	110
		0.6	0.80	0.126		
		0.8	0.40	0.116		
T5	1.3	0.2	1.04	0.127	0.117	120
		0.6	0.52	0.114		
		0.8	0.26	0.110		

In Table 4 the highest average velocity downstream of the Rapping main channel in November 2021 is located at T3 at a depth of 2.2 m with an average velocity of 0.139 m²/s with a sediment concentration value of 80 mg/l and the smallest velocity at T5 at a depth of 1.3 m with a velocity 0.117 m²/s with a sediment concentration value of 120 mg/l.

Table 5. Flow Rate and Sediment Concentration in Upstream Rapping Main Channel in May 2022

upstream	Depth H	Vertical Point	Depth (m)	Speed V(m/s)	V Average	Cs (mg/l)
T1	2.3	0.2	1.84	0.152	0.143	7704
		0.6	0.92	0.149		
		0.8	0.46	0.127		
T2	2.5	0.2	2.00	0.171	0.156	7744
		0.6	1.00	0.152		
		0.8	0.50	0.145		
T3	3.3	0.2	2.64	0.182	0.163	7267
		0.6	1.32	0.158		
		0.8	0.66	0.148		
T4	2.1	0.2	1.68	0.152	0.141	7814
		0.6	0.84	0.147		
		0.8	0.42	0.123		
T5	1.8	0.2	1.44	0.120	0.109	9120
		0.6	0.72	0.111		
		0.8	0.36	0.097		

In Table 5 the highest average velocity upstream of the Rappang main channel in May 2022 is located at T3 at a depth of 3.3 m with an average velocity of 0.163 m²/s with a sediment concentration value of 7267 mg/l and the smallest velocity is at T5 at a depth of 1.8 m with velocity 0.109 m²/s with a sediment concentration value of 9120 mg/l.

Table 6. Flow Rate and Sediment Concentration in the Middle of the Rappang Main Channel in May 2022

Middle	Depth H	Vertical Point	Depth (m)	Speed V(m/s)	V Average	Cs (mg/l)
T1	1.3	0.2	1.04	0.142	0.130	4824
		0.6	0.52	0.132		
		0.8	0.26	0.116		
T2	1.7	0.2	1.36	0.152	0.146	4946
		0.6	0.68	0.149		
		0.8	0.34	0.136		
T3	1.8	0.2	1.44	0.160	0.152	4482
		0.6	0.72	0.155		
		0.8	0.36	0.141		
T4	1.7	0.2	1.36	0.151	0.143	5283
		0.6	0.68	0.143		
		0.8	0.34	0.133		
T5	1.2	0.2	0.96	0.138	0.130	5901
		0.6	0.48	0.129		
		0.8	0.24	0.123		

In Table 6 the highest average velocity in the middle of the rappang main channel in May 2022 is located at T3 at a depth of 1.8 m with an average velocity of 0.152 m²/s with a sediment concentration value of 4482 mg/l and the smallest velocity at T5 at a depth of 1.2 m at a speed of 0.130 m²/s with a sediment concentration value of 5901 mg/l.

Table 7. Flow Rate and Sediment Concentration at Rappang Main Channel Downstream in May 2022

Downstream	Depth H	Vertical Point	Depth (m)	Velocity V(m/s)	V Average	Cs (mg/l)
T1	1.3	0.2	1.04	0.113	0.100	3487
		0.6	0.52	0.103		
		0.8	0.26	0.084		
T2	1.7	0.2	1.36	0.114	0.096	3341
		0.6	0.68	0.090		
		0.8	0.34	0.084		
T3	2.1	0.2	1.68	0.141	0.127	2644
		0.6	0.84	0.123		
		0.8	0.42	0.116		
T4	1.5	0.2	1.2	0.120	0.109	3522
		0.6	0.6	0.111		
		0.8	0.3	0.097		
T5	1.5	0.2	1.2	0.116	0.106	4707
		0.6	0.6	0.110		
		0.8	0.3	0.092		

In Table 7 the highest average velocity downstream of the Rappang main channel in May 2022 is located at T3 at a depth of 2.1 m with an average velocity of $0.127 \text{ m}^2/\text{s}$ with a sediment concentration value of 2644 mg/l and the smallest velocity is at T5 at a depth of 1.5 m with velocity $0.106 \text{ m}^2/\text{s}$ with a sediment concentration value of 4707 mg/l .

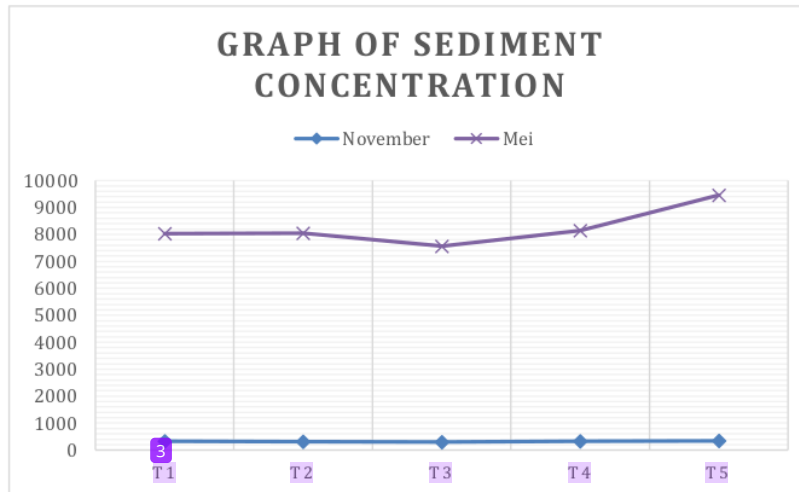


Figure 4. Graph of upstream sediment concentration rappang main channel

In Figure 4 explains that in the upstream of the Rappang main channel, the largest concentration is in May with an average sediment concentration value of 7930 mg/l and in November average sediment concentration value of 320 mg/l . This can prove that seasonal changes have resulted in very significant changes in sediment concentration.

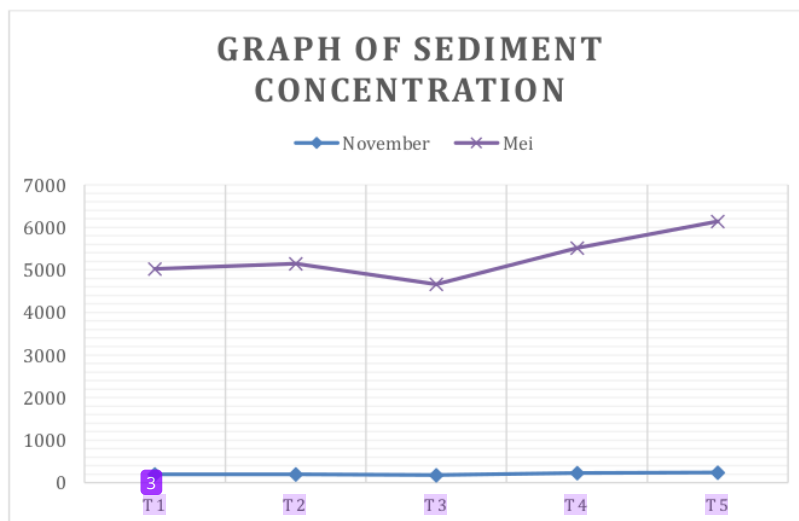


Figure 5. Graph of middlestream sediment concentration rappang main channel

In Figure 5 explains that in the middlestream of the Rappang main channel, the largest concentration is in May with an average sediment concentration value of 5087 mg/l and in November average sediment concentration value of 210 mg/l. This can prove that seasonal changes have resulted in very significant changes in sediment concentration

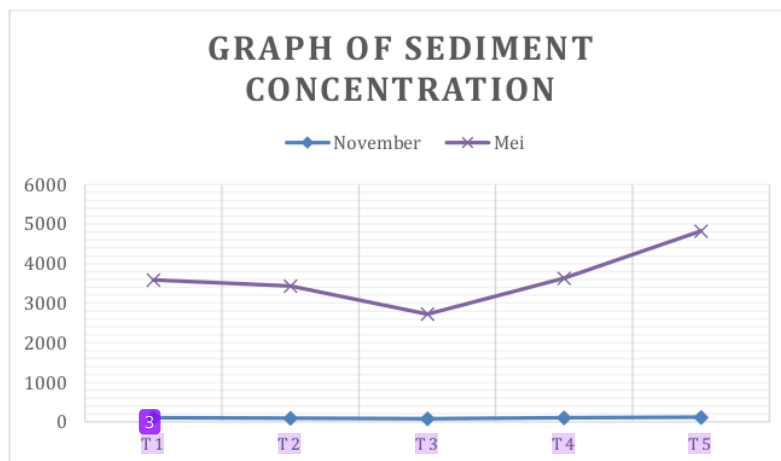


Figure 6. Graph of downstream sediment concentration rappang main channel

In Figure 6 explains that in the downstream of the Rappang main channel, the largest concentration is in May with an average sediment concentration value of 3540 mg/l and in November average sediment concentration value of 100 mg/l. This can prove that seasonal changes have resulted in very significant changes in sediment concentration

4. Conclusion



Figure 7. Sediment concentration value during season

In this Research knows that the sediment concentration greatly influences of seasonal changes In this study, it can be seen that the highest flow velocity and sediment concentration are located in May 2022. the largest concentration is in May with an average sediment concentration value of 7930 mg/l and in November average sediment concentration value of 320 mg /l. This can prove that seasonal changes have resulted in very significant changes in sediment concentration.

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