

## Sedimentation Analysis in the Cihaur Irrigation Channel, Cilacap Regency, Central Java

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### Keywords

Analysis, Irrigation Water Requirements, Discharge and aknop

### ABSTRACT

This research analyzes sedimentation in the *Cihaur* irrigation canal within the *Manganti Irrigation Area (D.I. Manganti)*, Cilacap Regency, which services 700 hectares of agricultural land out of a total of 26,153 hectares. The study examines how sedimentation impacts the capacity and efficiency of the 22.62 km long canal. Factors contributing to sedimentation, based on Sasrodarsono's theory (1989), include erosion areas, geological and topographical conditions, meteorological factors (particularly high rainfall intensity), hydraulic characteristics (flow rate of 136.524 m<sup>3</sup>/second), vegetation, and human activities within the *Citanduy River Basin (DAS Citanduy)*. The impacts of sedimentation include reduced canal capacity, decreased hydraulic efficiency, and increased maintenance costs. Using a descriptive analytical quantitative approach, the study incorporates discharge measurements, sedimentation volume analysis (20.405 m<sup>3</sup>/second), granulometric analysis (dominated by fine sand and silt with 58% silt content), and water content analysis (86% for settled sediment and 292% for floating sediment). Correlation analysis indicates that high rainfall intensifies sedimentation. Results reveal significant reductions in irrigation efficiency, such as a decrease in flow in the *Simpellu I* primary canal from 136.524 m<sup>3</sup>/second to 116.119 m<sup>3</sup>/second. Proposed solutions include sediment dredging, canal normalization, upstream erosion control (e.g., reforestation, terracing), construction of sediment control structures (e.g., sediment traps, settling ponds, check dams), routine cleaning and maintenance, and active farmer participation. Limitations of the study include the absence of long-term historical data and a narrow focus limited to the *Cihaur* irrigation canal.

## INTRODUCTION

The irrigation canal is located in the *Cihaur* area of Cilacap Regency, Central Java, and the focus of this research is sediment analysis. This research was conducted in the *Cihaur* Irrigation Canal in Cilacap Regency, Central Java. This location was selected based on initial survey results indicating significant sedimentation problems, which affect the efficiency of irrigation water distribution to agricultural land (Depeweg et al., 2015).

Irrigation canals play a crucial role in supporting the agricultural sector, particularly in providing an adequate water supply to farmland (Diwedard et al., 2024). However, sedimentation is often a major challenge, as it reduces both the efficiency and capacity of irrigation canals. Sedimentation occurs due to the deposition of solid materials such as mud, sand, and gravel carried by the water flow, which causes canal narrowing, increases the risk of flooding, and lowers the quality of irrigation water (Benavides-Muñoz, 2025).

In Cilacap Regency, Central Java, the *Cihaur* irrigation canal plays a vital role in sustaining agricultural productivity in the surrounding areas (Liang et al., 2019). Like other irrigation systems, the *Cihaur* canal is also vulnerable to sedimentation problems that hinder optimal water distribution (Gunawan & Sumiyati, 2018). Sediment accumulation in canals can result in several negative impacts, including reduced water flow reaching farmland, damage to water structures such as sluice gates and culverts, and increased maintenance costs due to routine dredging work (Gad et al., 2023).

Therefore, sedimentation analysis in the *Cihaur* irrigation canal is essential for understanding the characteristics of sediment deposits, sedimentation rates, and causal factors. A comprehensive understanding of these sedimentation patterns forms the basis for developing effective management strategies, such as designing sediment traps, optimizing canal operation and maintenance, and implementing erosion mitigation measures in upstream areas (Nepf, 2015; Selim et al., 2022; Selim et al., 2023). These efforts are expected to maintain the optimal performance of the *Cihaur* irrigation canal, support agricultural sustainability, and improve the welfare of farmers in Cilacap Regency (Munir, 2024).

Previous studies have examined sedimentation in irrigation canals, particularly its impact on agricultural efficiency. For instance, Taufiq et al. (2018) analyzed sedimentation in irrigation systems in Java and highlighted its effects on water flow and canal capacity. They concluded that sediment accumulation significantly impedes water distribution to farmland, thereby reducing productivity (Shrestha et al., 2023; Singh et al., 2025; Zhang et al., 2024). Similarly, Supriyadi and Marwoto (2019) investigated sedimentation processes in canals in Central Java, finding that excessive sedimentation exacerbates maintenance costs and damages canal structures. However, both studies primarily focused on the physical impacts of sedimentation on water flow and infrastructure, without providing a deeper analysis of sediment characteristics and the causal factors contributing to the problem.

This study seeks to fill that gap by offering a comprehensive analysis of sediment types, sedimentation rates, and the underlying causes of sedimentation in the *Cihaur* irrigation canal in Cilacap Regency. It also aims to develop practical management strategies, including the design of sediment traps and the optimization of canal operation and maintenance practices. The objectives of this research are to understand sedimentation patterns, identify key contributing factors, and propose effective solutions for mitigating sedimentation. The expected benefits of this study include improving the efficiency of the *Cihaur* irrigation canal, supporting agricultural sustainability in the region, and enhancing the welfare of farmers by ensuring optimal water distribution and reducing maintenance costs.

## **METHOD**

The object of this research is the Ciwaringin Dam, located in Lame Village, Leuwimunding District, Majalengka Regency. The following is a map of the research location:



**Figure 1. Map of research location**  
Source: Google Earth Pro

This research was conducted in the *Cihaur* Irrigation Canal in Cilacap Regency, focusing on points affected by sedimentation. The method used in this study was quantitative, with the aim of providing an understanding of the social phenomena and field realities through observation and structured interviews to describe existing conditions. This approach is expected to evaluate the performance of the primary and tertiary irrigation systems in accordance with *PUPR Ministerial Regulation No. 12/PRT/M/2015*. The data required for this study consisted of both primary and secondary data.

Primary data were obtained from direct field measurements, including channel dimensions (width, height, and water depth), flow velocity, and sedimentation volume. Sediment samples were collected from several points along the canal for granulometric and material content analysis.

Secondary data were gathered indirectly from other sources that were available prior to the research. These included rainfall data, water discharge records, irrigation area maps, and technical reports from relevant agencies, particularly the Cilacap Regency Water Resources Management Agency.

- 1) Map
- 2) Irrigation Network Scheme for the Manganti Irrigation Area
- 3) Irrigation Asset Data, etc.



**Figure 2. Cihaur Dam**  
Source: Personal Documents

Data collection techniques used in this study.

#### A. Field Survey

Using measuring instruments such as a current meter to measure flow velocity, a measuring ruler (tape measure) to measure channel dimensions, and a coring sampler to collect sediment.

#### B. Interviews

Conducted with farmers and irrigation management officers to obtain qualitative information regarding maintenance frequency, the impact of sedimentation on water flow, and control strategies implemented.

#### C. Documentation

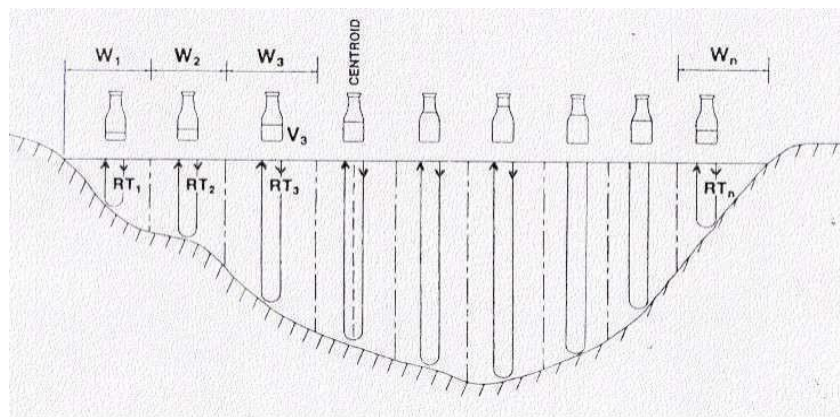
Collecting documents and technical reports from authorized agencies, as well as photographic documentation of channel conditions.

#### D. Primary Data

Primary data is data obtained based on field observations. The primary data obtained is data from observations and observations conducted at the research location. The data collected includes:

#### E. Sediment Collection

Sediment collection was carried out using the Equal Width Increment (EWI) method, which divides the river cross-sectional width into several sections. The same section depends on the number of samples to be taken. Vertical sampling is located at the center of the cross-sectional area where the sample is taken.



**Figure 3. How to take sediment samples using the EWI method.**

Sampling was conducted using both point sampling and depth-integrated methods. The sampling time was determined by the flow velocity and channel dimensions. The sample volume was 500 grams per section, with samples taken at each stake or *STA*.

This research employed a qualitative method with a descriptive-inductive approach. The descriptive approach aimed to provide an overview and explanation of the data and information collected during the research process. Meanwhile, the inductive approach was carried out through a reasoning process based on field findings or empirical facts (Sulistijo, 2023). Through this descriptive-inductive qualitative method, the study sought to describe the conditions of the research subjects and objects in accordance with the facts obtained.

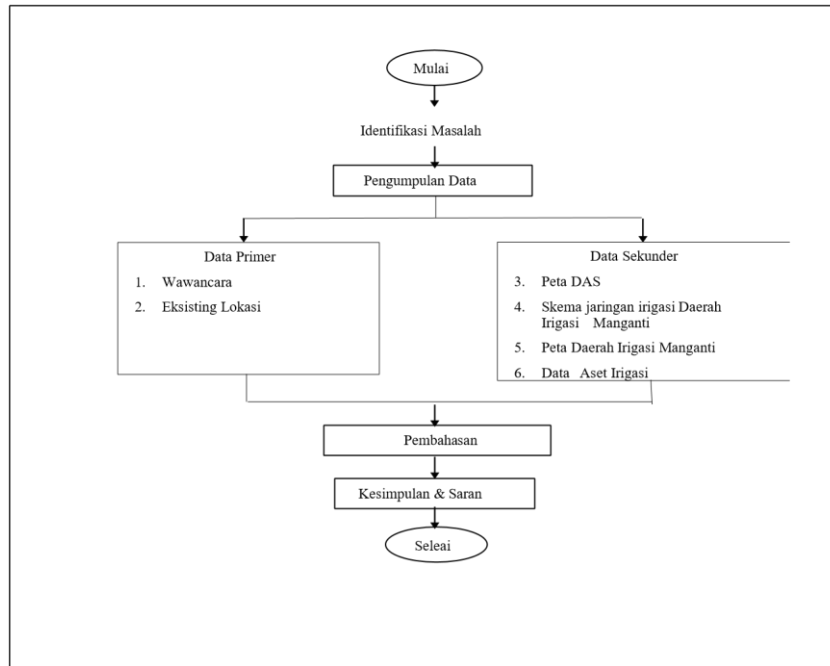


Figure 4. Research Flowchart

Source: Processed Data, 2025

In any analysis or research, there are formulas used to calculate the results. In this analysis, the formulas used in the calculations include:

Steps to be taken in analyzing data to evaluate the performance of the Manganti Irrigation System in Ciamis Regency and Cilacap Regency using manual calculations using Microsoft Excel.

- a. Water Content Testing
- b. Sludge Content Calculation
- c. Specific Gravity Calculation
- d. Sieve Analysis

Data analysis was conducted quantitatively using the following steps:

Sedimentation Volume Analysis

Sedimentation volume was calculated based on measurements of sediment thickness and channel cross-sectional area. The formula used was:

$$V = A \times T$$

**Note:**

V = Sediment volume (in cubic meters / m<sup>3</sup>)

A = Cross-sectional area of the channel where sedimentation occurs (in m<sup>2</sup>)

T = or height of the sediment layer (in meters)

Calculating irrigation channel discharge for sedimentation analysis purposes is important to ensure that the water flow is strong enough to transport sediment, but not so strong that it causes excessive erosion. This discharge is usually calculated.

## RESULTS AND DISCUSSION

The Manganti Irrigation Area covers a total service area of 26,153 hectares, divided into two main irrigation networks: the Sidareja, Cihaur, and South Lakbok irrigation networks. The Sidareja and Cihaur Irrigation Networks (left intake) irrigate 21,518 hectares of Cilacap Regency. The South Lakbok Irrigation Network (right intake) irrigates Ciamis and Pangandaran Regencies, covering 4,616 hectares. The main source of irrigation water comes from the Cintanduy River, which is dammed at the Manganti Dam, located in Kedungreja District, Cilacap Regency, Central Java, and Lakbok District, Ciamis Regency, West Java. The provision of irrigation water aims to optimize irrigation services in the Manganti District, including improving the cropping index. Research Analysis Results The tools and materials used are outlined in the sequence of activities in the table below:

**Table 1. Tools and Materials**

No.	Activity	Materials	Tools
1.	Flow depth measurement	-	Ruler
2.	Water velocity measurement	-	Stopwatch, current meter
3.	Suspended sediment measurement	Water and transported sediment	Sample bottle, permanent marker
4.	Channel width measurement	-	Meter
5.	Channel Discharge Calculation (Q)	-	General Channel Discharge Formula (Q)
	<b>Formula:</b> $Q = A \times V$	-	-
	<b>Note:</b>	Q = Flow Discharge (m <sup>3</sup> /s)	-
		A = Channel Cross-Section Area	-
		V = Flow Velocity (m/s)	-
	<b>Example Calculation:</b>	$Q = 40,811 \text{ m}^2 \times 3.345 \text{ m}^3/\text{s}$	$Q = 136,524 \text{ m}^3/\text{s}$
6.	Channel Cross-Section Area (A)	-	Depends on the channel shape, but it is commonly trapezoidal
	<b>Formula:</b> $A = B + T \times H/2$	B = 9 m (Base Width), H = 20 m (Top Width), H = 4.625 m (Water Level/Depth)	-
	<b>Calculation:</b>	$A = 9 + 20 \times 4.625/2$	$A = 40,811 \text{ m}^2$
7.	Flow Velocity (V)	-	<b>Formula:</b> $V = Q / A$
	<b>Calculation:</b>	$V = 136,524 / 40,811$	-
8.	Sedimentation Volume Analysis	-	Sediment thickness and channel cross-sectional area
	<b>Formula:</b> $V = A \times T$	T = Sediment Height	-
	<b>Example Calculation:</b>	$V = 40,811 \text{ m}^2 \times 0.50 \text{ m}$	$V = 20,405 \text{ m}^3/\text{s}$

### Soil Sample Testing

Soil samples were taken directly from the primary canal of the Cihaur River Basin, in the inlet and mud pocket sections. The soil samples were then taken to the laboratory for testing. The laboratory tests performed included sediment specific gravity, sieve analysis, mud content, and water content. The laboratory test results are as follows:

Specific gravity

PENGUJIAN BERAT JENIS (ASTM D 854-90)				
JUDUL KITAM : ANALISIS SEDIMENTASI PADA SALURAN IRIGASI CHAUR KAB. CILACAP JAWA TENGAH				
LOKASI : D.I MANGANTI INTEK CHAUR - SIDAREJA				
No.	No. Contoh	Unit	Sampel 1	
			A	B
1	No. Piknometer			
2	Berat Piknometer	gram	38,700	47,800
3	Brt. Piknometer + tanah kering	gram	105,000	117,600
4	Berat tanah kering (3 - 2)	gram	66,300	69,800
5	Temperatur	° C	21	21
6	Brt. Piknometer + tanah + air	gram	179,200	191,100
7	Berat Piknometer + air	gram	138,200	148,700
8	Berat Piknometer + air + (tanah) (4 + 7)	gram	204,500	218,500
9	Isi tanah (8 - 6)	cm <sup>3</sup>	25,300	27,400
10	Berat jenis tanah (4 : 9)	gram	2,621	2,547
11	Berat jenis rata-rata	gram	<b>2,584</b>	
12	Berat jenis terbesar		1,029	
	Berat jenis terkecil	< 1,02		

Figure 5. Specific Gravity Test Results

Specific Gravity Test Results

2.584 g/cm<sup>3</sup>

Closely related to pure mineral soils such as kaolinite or quartz. It can originate from predominantly sand and silt sediments without much organic matter. It is consistent with river sediments or clayey sand excavation materials 2.164 g/cm<sup>3</sup>

This value is lower than that of ordinary mineral soils. It may indicate a moderate to high organic matter content. It may also indicate the presence of light minerals such as water-bearing clay (wet montmorillonite). It may originate from fine-grained sediments in swamps, deltas, or flooded areas.

2.534 g/cm<sup>3</sup>

Closely related to pure mineral soils such as kaolinite or quartz. It can originate from predominantly sand and silt sediments without much organic matter. It is consistent with river sediments or clayey sand excavation materials.

Table 2. Specific Gravity Test


Specific Gravity	Material Possibilities	Information
2.584 g/cm <sup>3</sup>	A mixture of sand and mud, light minerals, or river	Common in alluvial sediments, river
2.164 g/cm <sup>3</sup>	Clay containing light organic matter or wet clay material	

2.534 g/cm <sup>3</sup>	Mixture of sand and mud	Common in alluvial sediments, light minerals, or river
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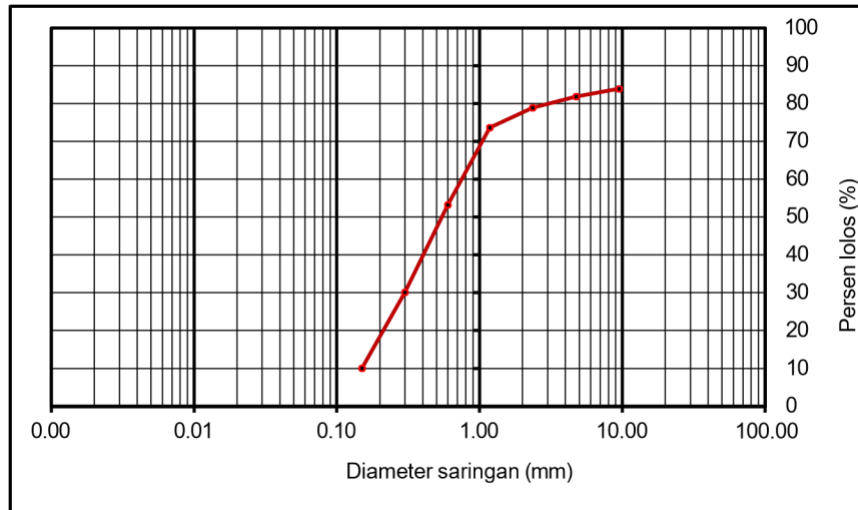
**Sieve Analysis Results**

The sieve analysis test is carried out by selecting the gradation level based on the grain size. After the sieve analysis test, the data is entered into a grain gradation presentation table, which will then be used as input for subsequent calculations. In this study, three samples were taken, representing each STA or benchmark studied.

As shown in the attached table, the largest percentage of sieve analysis results in the soil mechanics laboratory, sieve number 200 has the largest percentage of remaining, with a value of 28.2%. This percentage makes the samples taken from the Cihaur Primary Irrigation Canal dominated by fine sand and mud. After obtaining the grain gradation results from the sediment samples, the next step is to obtain the average grain diameter of the samples, the percentage of which is shown in the figure.

		<b>LABORATORIUM FAKULTAS TEKNIK UNIVERSITAS SWADAYA GUNUNG JATI CIREBON</b>		<b>ANALISIS BUTIRAN ASTM C136 / JIS A 1102</b>	
JUDUL KITAM : ANALISIS SEDIMENTASI PADA SALURAN IRIGASI CIHAUR KAB.CILACAP JAWA TENGAH LOKASI : D.I MANGANTI INTEK CIHAUR - SIDAREJA					
<b>A. FRAKSI HALUS</b>			BERAT CONTOH KERING : 1.593,0 gr		
Ukuran Saringan		Berat Tertahan	Jumlah Berat Tertahan	% Berat Tertahan	% Lolos
( mm )	( inch )	( gr )	( gr )	( % )	( % )
9,50		255,00	255,00	16,04	83,96
4,75		33,00	288,00	18,11	81,89
2,36		47,00	335,00	21,07	78,93
1,18		83,00	418,00	26,29	73,71
0,60		325,0	743,00	46,73	53,27
0,30		368,0	1.111,00	69,87	30,13
0,15		319,0	1.430,00	89,94	10,06
0,075		98,00	1.528,00	96,10	3,90
Pan		62,00	1.590,00	100,00	0,00
Jumlah		1.590,00			

**Figure 6. Results of Grain Analysis**



**Figure 7. Average Grain Diameter Graph**

**Interpretation of Results**

**a. Size Distribution**

The percentage of material passing through (finer) is very high on the fine sieve, which means that most of the material is fine to very fine. This soil is not predominantly gravel or coarse sand, but leans more towards fine sand, silt, or clay

**b. Dominant size**

The dominant size can be estimated from the sieve by the drastic decrease in % passing: At the 0.60 mm sieve → only 53.27% passed, indicating the dominant grain size is around there. This material is classified as fine sand to silt.

**c. Percentage passing sieve No. 200 (0.075 mm)**

3.90% passes 0.075 mm (meaning 3.90% is clay and silt fractions). Therefore, this soil is not classified as predominantly fine soil, because the fine fraction is <50%. This means that this soil tends more towards sand (sand).

**d. Based on Classification (USCS / AASHTO) – roughly based on this data:**

Fraction passing sieve No. 4 (4.75 mm) = 81.89% Fraction passing sieve No. 200 (0.075 mm) =

3.90% These results indicate:

>50% pass No. 4 → can be classified as sand.

<5% pass No. 200 → means clean sand, without much fine material.

So provisionally (without further testing such as Atterberg limits): This material is most likely classified as clean sand (SP or SW) in the USCS system.

So the conclusion is that the material is dominated by sand size, especially medium to fine sand. Low fines (silt/clay) content (3.9%).

**Sludge Content Analysis Results**

Silt content refers to the percentage of fine particles in the soil, generally smaller than 0.075 mm (No. 200 sieve). These particles consist of silt and clay. Laboratory test results are shown in the following table:

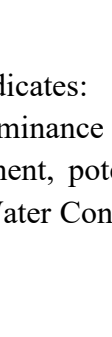
LABORATORIUM FAKULTAS TEKNIK UGJ- CIREBON		PEMERIKSAAN JUMLAH BAHAN LOLOS # 200 DAN KADAR LUMPUR			
JUDUL KITAJ : ANALISIS SEDIMENTASI PADA SALURAN IRIGASI CIHAUR KAB.CILACAP JAWA TENGAH LOKASI : D.I MANGANTI INTEK CIHAUR - SIDAREJA					
A	Berat contoh kering sebelum dicuci	gram	451,9	459,6	462
B	Berat contoh kering setelah dicuci	gram	188,4	192,6	188,2
C	Berat contoh yang lolos saringan No. 200	gram	263,5	267	273,8
Persentase lolos # No. 200 $\frac{C}{A} \times 100$		%	58,31	58,09	59,26
Persentase lolos # No. 200				58,20	
Cirebon, 9 Juni 2023 Mengetahui Kepala Laboratorium FAKULTAS TEKNIK UJG- Cirebon  LABORATORIUM UNSWAGATI TEKNIK UNSWAGATI CIREBON NIKKO BOZY ST, MT NIK. 64790569					

Figure 8. Results of Sludge Content Analysis

- a. If the silt content in the channel sediment reaches 58%, this indicates that the sediment is dominated by fine particles, and can have important implications for channel quality, erosion, sedimentation, and flow capacity.
- b. Explanation of 58% Silt Content

In the context of sediment, “silt” generally refers to the fine fraction consisting of

From:

(clay): < 0,002 mm

(silt): 0,002 – 0,063 mm

So, a silt content of 58% means: 58% of the total sediment weight consists of particles smaller than 0.063 mm, namely silt + clay.

### Interpretation of Value 58%

This is a high value, meaning very fine sediment, which generally indicates:

So, a mud content of 58% in the channel sediment indicates a predominance of fine particles (clay and silt), indicating sedimentation in a low-energy environment, potentially causing siltation and impacting the environmental quality of the waterway. Water Content Analysis

Water Content Analysis

LABORATORIUM FAKULTAS TEKNIK UNIVERSITAS SWADAYA GUNUNG JATI CIREBON		PENGUJIAN KADAR AIR (ASTM 2216)			
JUDUL KITAP : ANALISIS SEDIMENTASI PADA SALURAN IRRIGASI CHAUR, KAB. CLACAP, JAWA TENGAH LOKASI : D.I MANGANTI INTEK CHAUR - SIDAREJA					
No. Contoh					
Kedalaman (m)					
No. Cawan		Sampel 1	Sampel 2	Sampel 3	
1	Berat Cawan + tanah basah	gr	115.4	119.8	100.8
2	Berat Cawan + tanah kering	gr	70.6	68.5	69.9
3	Berat Cawan	gr	13.30	14.1	13.4
4	Berat air ( 1-2 )	gr	44.8	51.3	40.9
5	Berat tanah Kering ( 2-3 )	gr	57.30	54.4	46.5
6	Kadar air ( 4 / 5 x 100 )	%	78.18	94.30	87.96
7	kadar air rata-rata	%		86.81	
Ceterangan :					

Figure 9. Results of the Analysis of the Water Content of the Settled Sample

LABORATORIUM FAKULTAS TEKNIK UNIVERSITAS SWADAYA GUNUNG JATI CIREBON		PENGUJIAN KADAR AIR (ASTM 2216)			
JUDUL KITAP : ANALISIS SEDIMENTASI PADA SALURAN IRRIGASI CHAUR, KAB. CLACAP, JAWA TENGAH LOKASI : D.I MANGANTI INTEK CHAUR - SIDAREJA					
No. Contoh					
dalaman (m)					
No. Cawan		Sampel 1	Sampel 2	Sampel 3	
1	Berat Cawan + tanah basah	gr	92.8	90.5	76.4
2	Berat Cawan + tanah kering	gr	34	34.1	30.1
3	Berat Cawan	gr	13.50	14	15.2
4	Berat air ( 1-2 )	gr	58.8	56.4	46.3
5	Berat tanah Kering ( 2-3 )	gr	20.50	20.1	14.9
6	Kadar air ( 4 / 5 x 100 )	%	286.83	280.60	310.74
7	kadar air rata-rata	%		292.72	
Ceterangan :					

Figure 10. Results of Floating Sediment Water Content Analysis

The Analysis of the Water Content of the Settled Sample Moisture content 86% Moisture content 86% (possible wet base/sediment. This means that 86% of the total weight of sediment is water, and only 14% is solids (dry soil). This is especially common for muddy sediments or water-saturated clays.

With sediment characteristics that still maintain their shape but are very sticky and wet, this sediment is usually found in river deposits, swamps, deltas, or sedimentation ponds.

- a. Water content 292% (possible dry basis – dry basis/floating sediment) This means that the weight of the water is 2.92 times more than the dry weight of the soil.
- b. So the results of this water content test show a very high water content, indicating that the sediment is very saturated or submerged, such as mud, organic clay, or early peat.

### Rainfall Analysis

Based on rainfall data from the Meteorology, Climatology, and Geophysics Agency (BMKG), the Cihaur area, D.I. Manganti, Cilacap Regency, has experienced quite high rainfall intensity in recent times. This information serves as an important basis for analyzing sedimentation levels in irrigation channels in the region, considering that high rainfall can increase soil erosion and accelerate the rate of sediment deposition along irrigation channels

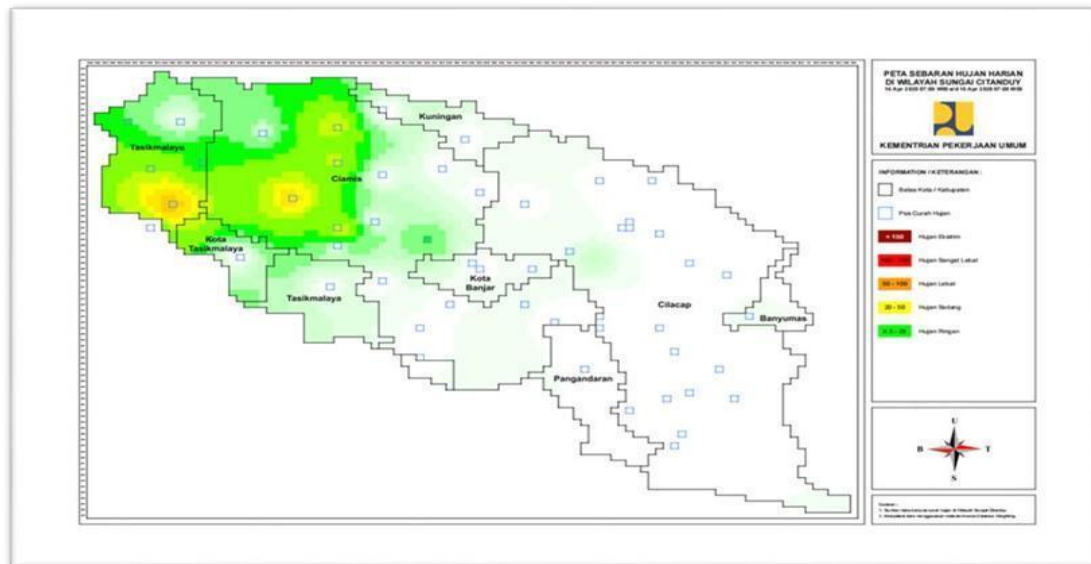


Figure 11. Map of Daily Rainfall Distribution in the Citanduy River Basin



Figure 12. Rainfall Data in the Cihaur Area

Water Discharge Analysis

No	Nama Sungai	TMA/Debit	Status
1	Sungai Citanduy		Normal
	Pos Pataruman		
	TMA max (m)	1.94	
2	Sungai Cimuntur		Normal
	Pos Batununggul		
	TMA max (m)	3.39	
3	Sungai Ciseel		Normal
	Pos Binangun		
	TMA max (m)	1.50	
4	Sungai Cikembang		Normal
	Pos Situbatu		
	TMA max (m)	0.56	
5	Sungai Cijolang		Normal
	Pos Bebedahan		
	TMA max (m)	1.40	
6	Sungai Cimoneng		Normal
	Pos Stinggil		
	TMA max (m)	0.09	
7	Sungai Cikawang		Normal
	Pos Cukangleuleus		
	TMA max (m)	3.30	
		128.77	

DI WILAYAH INDONESIA	
KE TERANGAN	
BINGKAS	1 - 5 mm/jam; atau 5 - 20 mm/hari
SE DANG	5 - 10 mm/jam; atau 20 - 50 mm/hari
LEBAT	10 - 20 mm/jam; atau 50 - 100 mm/hari
SANGAT LEBAT	> 20 mm/jam; atau > 100 - 200 mm/hari
EKSTREM	> 200 mm/hari

Figure 13. Water Discharge

## CONCLUSION

Based on the research results, the following conclusions can be drawn. First, the factors causing sedimentation in the *Cihaur* Irrigation Canal, *Manganti Irrigation Area*, *Cihaur District*, Cilacap Regency, are a complex combination of natural and anthropogenic elements. Natural factors include high rainfall intensity, the geological and topographical characteristics of the *Citanduy River Basin (DAS)* that influence erosion rates, and the river's hydraulic characteristics that affect sediment transport. Second, sedimentation significantly impacts irrigation system performance, leading to reduced channel capacity, decreased hydraulic efficiency, increased maintenance costs, and disruptions to supporting structures. Third, controlling sedimentation requires an integrated strategy, including upstream erosion control (such as reforestation, terracing, and mulching), construction of sediment control structures (e.g., sediment traps, settling ponds, and check dams), improvements in irrigation channel design (considering flow velocity, channel shape, and surface roughness), routine cleaning and maintenance, and active participation from farmers and institutions to ensure sustainable development. For future research, it is recommended to examine the effectiveness of specific erosion control techniques and sediment management systems in improving long-term irrigation performance and reducing costs. Additionally, future studies could focus on the role of technology and data analysis tools in optimizing irrigation management and monitoring sedimentation processes.

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