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Performance Analysis of Katiga Dam Irrigation Network Kuningan Regency

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ABSTRACT

Keywords: Debit; Water Needs ; Network Irrigation

Weir Third is one of the dams in Kuningan West Java. Dam Third, located on Jl. New East Ring Road, Tonjong Hamlet, Sangkanmulya Village, District Cigandamekar, Regency Kuningan. The distance from the city of Brass is not enough, more than 13 km towards the north and less than 24 km from Cirebon city to the south direction. Dam Third irrigates an area of ± 1,010 Ha, covering two districts: Regency Kuningan 348 Ha and Cirebon Regency 662 Ha. Buildings are mainly third in the form of channel parent and channel secondary. Research objectives This analyzes mark performance based on condition damage, knowing performance moment this, get weight component Channels and Buildings Weir Third. The author uses primary data and secondary data. Primary data is obtained from field observations, while secondary data is from UPTD SUP Kalijaga – Cisanggarung. The methods used in the research Are qualitative nature, descriptive – and inductive. Research results show that the percentage performance component Channels and Structures on Dams Third based on conditions and functions, namely, Channel Primary and Secondary Weir Third with a percentage condition good 15%, condition medium 50%, condition damaged 34%, so the average condition channel Primary and Secondary Weir Third in Moderately Damaged Condition. The condition of the building on Dam Third is good at 7%, moderate condition at 85%, and damaged at 9%, so Weir Third's average condition is good. The result of the analysis calculation of rainfall rain and comparison of discharge needs with the debit of irrigation area availability shows that the debit availability river is bigger than the debit requirement, with thus water needs in irrigation areas being third in all-sufficient.

Introduction

Weir Third is a dam located in the Regency Kuningan, West Java. Based on astronomical location, Dam Third is at coordinates 6°88'87.7” S and 108°50'78. 7” E. Weir Third, located on Jl. New East Ring Road, Tonjong Hamlet, Sangkanmulya Village , District Cigandamekar , Regency Kuningan . Distance from the city Kuningan is less than 13 km towards the north and less than 24 km from Cirebon city to the South direction. Dam Third's channel parent is Weir Third or DI Katiga. Dam Third is capable of irrigating two sub-districts, Cigandamekar Regency Brass, with a total area of 348 Ha and Subdistrict Sedong Cirebon Regency, with a total area of 662 Ha, and Weir Third is capable of irrigating the irrigation area with an amount of total of 1010 Ha (Purwanto & Ikhsan, 2016; Sida & Mustari, 2018).

Referring to the problem, research This discusses performance network irrigation, especially on Channel Parent, based on the building's aspect conditions and structural functions. Some parts of the building, Channel Primary and Secondary, will be investigated more physically and theoretically to produce criteria for Channel Primary and Secondary (Khaerunisa, 2014; Muhammad Isla & Risti Puspita Sari Hunowu, 2022).

Research purposes This is to analyze the percentage performance channel Katiga Bending Parent based on condition damage, analyze condition performance Channel Secondary Weir Third based on evaluation conditions and functions building the components, and obtain weight component Channel Primary and Secondary Weir The third one that can be used as indicator performance Channel based on conditions and functions its components (Alfian, 2010; Farida, 2016; Hrozencik et al., 2021).

Methods

Study location This is located in the Irrigation Area Weir. The third-most specified is the Channel Parent Weir (Yuniati, 2021). The third one is in Tonjong Hamlet, Sangkanmulya Village, Sub-district Cigandamekar, Regency Kuningan. The research was conducted from May to July 2024. The research started with retrieving related data from channel parent Weir Third in SUP (Service Unit) Kalijaga—Cisanggarung. Then, the survey was conducted upstream of Channel Parent until the downstream Channel Secondary Third.

Methods used in the research This method is qualitative, descriptive, and inductive. Research of this nature is descriptive and intended. It can give a description and explanation of the data and information obtained during the research, while the approach is inductive based on thought processes, observations in the field, and empirical facts.

Then, the upstream survey Channel Parent until the downstream Channel Secondary Weir Third. Data collection is in the form of primary flats, results observation directly in the field, and damage, type, and condition of physique channels and buildings. Weir Third. Secondary data originate from agency-related sources.

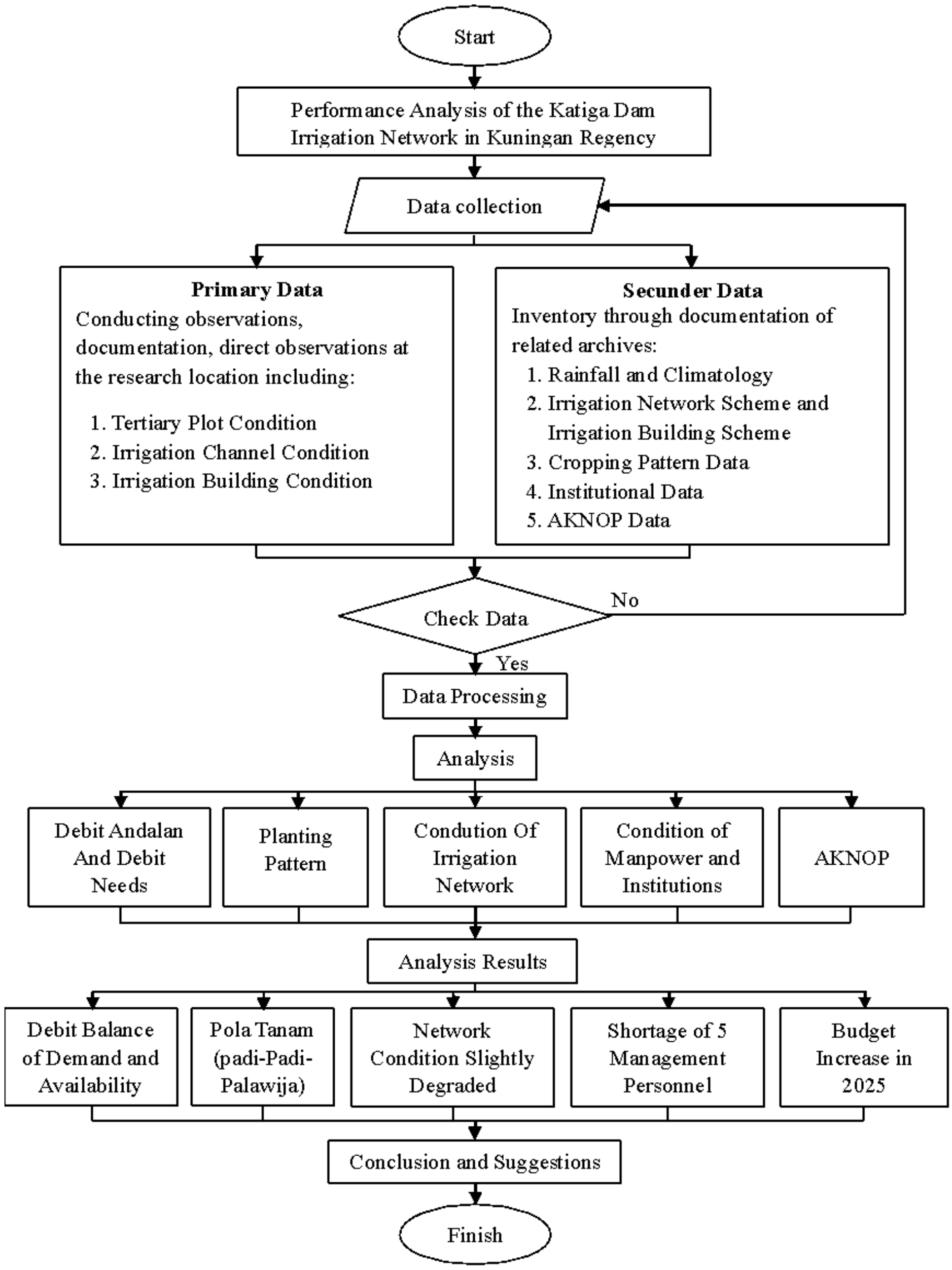

Figure 1. Research Flowchart

Source: Data processed, 2024

In an analysis or research, there are formulas used to calculate the results of the analysis, and in this analysis, the formulas used in the calculations include: (Magdalena et al., 2020)

- **Polygon Thiessen**

$$R = \frac{A1R1 + A2R2 + A3R3 + ...+ AnRn}{A1+A2+A3+ .....+An}$$

Information:

R : Average rainfall (mm)

$R_1, R_2, R_3, \ldots, R_n$: Rainfall at stations 1,2,3 and n is amount dot, dot, dot observation

$A_1, A_2, A_3, \ldots, A_n$: Area of the bounded polygon

- **Debit Andalan**

$$R_{80} = n/5 + 1$$

Information:

R_{80} : Rainfall effective monthly

n : Period duration observation

- **Potential Evaporation (Eto)**

$$Etc = Kc \times Eto$$

Information:

Etc : Evapotranspiration plants (mm/day)

Eto : Evapotranspiration plants (mm/day), calculated using the Penman Method modification

Kc : Coefficient plant

- **Water Needs in Rice Fields**

$$KAS = \text{"a"} \times Area$$

Information:

KAS : Water Needs in Rice Fields

“a” : Irrigation Water Requirements

Area : Planting Area

Results and Discussion

1. Thiessen Polygon

Based on the River Basin Map, rainfall is the bulk data Rain Station Linggarjati, Station Cigugur, and Station Ciawigebang. To obtain the area of each station's rainfall rain and the entire station area's rainfall rain, then use one of the Thiessen polygon methods as follows:

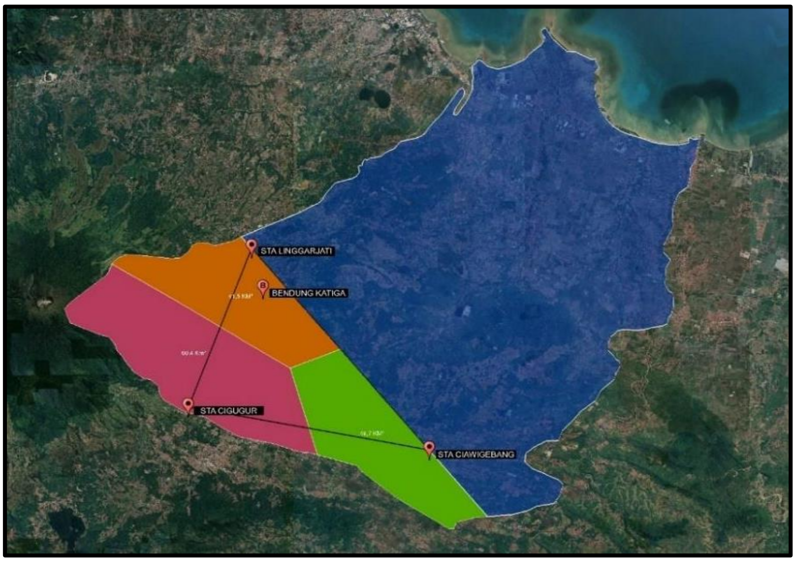

Figure 2 Thiessen polygon Weir Third

From the results analysis, the Thiessen Polygon method can obtain the area of each station's rainfall Rain that is:

Table 1. The Influence of Thiessen Polygons on Watersheds

Station	Thiessen Factor Polygon	
	Area (Km²)	Percentage (%)
Linggarjati	41.9	27.57
Cigugur	63.2	41.58
Ciawigebang	46.5	30.59
Total	151.6	100

Source: Calculation Results

2. Analysis Hydrology

Table 2. Average Annual Rainfall of 3 STAs

YEAR	Rainfall Station (mm)		
	Linggarjati	Cigugur	Ciawigebang
2011	9.49	8.32	7.59
2012	7,27	7,42	9,16
2013	13,75	8,60	9,98
2014	8,45	7,83	7,94
2015	11,12	8,61	7,65

2016	10,00	7,97	7,03
2017	11,98	7,96	5,86
2018	10,93	7,85	6,30
2019	10,36	8,00	6,30
2020	11.43	7.91	10.22
Amount	104.78	80.45	78.04
Average	10.48	8.04	7.80

Source: Calculation Results

3. Analysis Debit Andalan

Before calculating the mainstay debit of 80%, namely estimate the large discharge of flowing water, then sort the debits from the largest to the smallest (Mayasari et al., 2012). To determine the 80% mainstay debit, here are the details of the debt that has been sorted:

Table 3. 80% Semi-Monthly Debit

Month		**Order**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
January	I	7,082	5,538	4,557	4,758	4,478	3,578	3,033	**3,033**	3,083	2,185
	II	6,719	6,038	5,197	5,562	5,208	5,170	4,816	**4,688**	2,609	2,609
February	I	6,906	6,664	5,806	5,813	5,737	5,393	5,393	**4,981**	4,018	2,926
	II	6,201	7,447	7,447	5,726	4,809	3,977	4,650	**4,493**	2,981	1,906
March	I	5,909	6,864	6,864	6,774	5,915	5,696	6,037	**5,452**	5,368	4,171
	II	5,864	6,255	5,386	4,858	3,792	3,791	3,766	**3,186**	3,070	2,800
April	I	7,060	8,444	5,530	5,359	4,828	4,160	3,623	**3,556**	3,556	2,714
	II	4,703	5,954	4,728	3,695	3,356	2,268	2,050	**3,167**	3,167	2,413
May	I	3,224	3,923	3,719	2,545	2,478	2,626	2,626	**2,470**	2,102	1,877
	II	4,441	4,728	4,017	3,626	2,136	1,752	2,479	**2,479**	2,482	2,340
June	I	2,936	3,089	2,352	2,626	2,626	2,041	1,838	**2,484**	2,340	1,301
	II	3,733	4,699	2,333	1,616	1,529	2,803	2,178	**1,804**	2,206	2,472
July	I	3,290	3,070	2,099	2,626	2,626	1,886	1,769	**1,656**	2,484	0.754
	II	4,148	4,728	2,729	1,894	1,378	0.982	2,178	**1,804**	2,206	2,472
August	I	3,290	3,070	2,607	2,626	2,626	2,174	2,484	**1,769**	1,571	3,239
	II	4,148	4,728	2,729	1,894	1,378	0.870	2,178	**1,804**	1,443	2,472
September	I	2,423	2,607	2,626	2,626	2,174	2,332	2,484	**1,769**	1,571	0,529
	II	2,921	2,356	2,225	2,021	1,977	1,378	1,485	**2,178**	1,804	2,472
October	I	2,948	3,070	2,626	2,626	2,174	2,332	2,374	**1,482**	1,638	1,464

	II	3,484	2,312	2,346	1,576	1,576	1,717	1,729	**1,740**	1,026	1,778
November	I	4,048	5,128	4,797	4,360	4,044	3,157	2,063	**1,603**	1,597	2,062
	II	4,483	4,215	3,758	3,261	3,081	3,081	2,884	**2,177**	2,119	1,491
December	I	3,966	4,943	4,071	3,701	3,123	3,701	3,611	**4,244**	3,414	2,727
	II	6,461	4,937	5,016	3,336	3,336	3,336	3,267	**2,862**	2,540	2,508

Source: Calculation Results, 2024

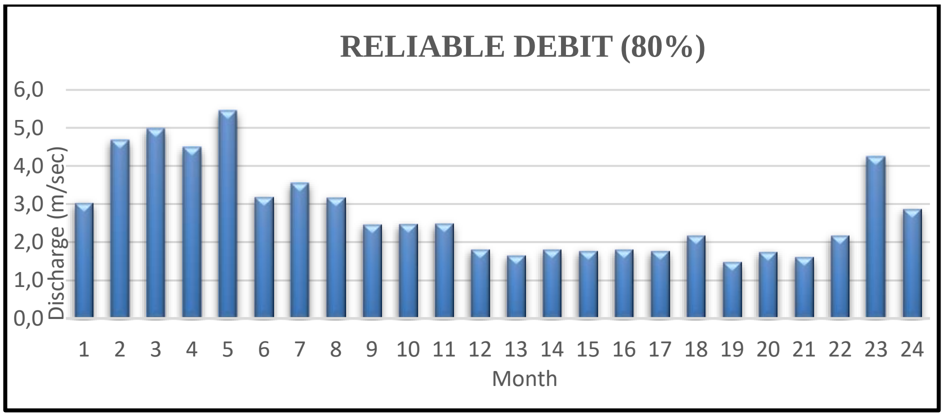

Figure 3. 80 % Half Debit Graph Monthly

Source: Data processed, 2024

4. Evaporation Potential (Eto)

The quantities used in the calculation are the evaporation rate, transpiration rate, and evapotranspiration rate with units of mm/day. The ETo value is used as a reference to estimate plant water requirements and irrigation management and can be calculated as follows:

Eto (mm/day) = c x Eto
= 1.10 x 4.55
= 5.01 mm/day

For other calculations, they can be presented in Table 4.

Table 4. Evaporation Potential (ETo)

Month	Eto (mm/ day)
January	5.01
February	5.12
March	5.44
April	4.76
May	4.89
June	4.81
July	5.30
August	6.78
September	8.53

October	8.00
November	6.56
December	5,36

Source: Calculation Results, 2024

5. Water Requirements

Preparation of land For paddy starting in November

Location taken = 2 mm/day

Land preparation time (T) = 15 days

Saturation = 250 mm

Clean water needs in rice fields (NFR) for paddy can calculated :

NFR = ETc + P + WLR + Re
= 6.56 + 2 + 0 + 0.48
= 9.04 mm/ day

Clean water needs in rice fields (NFR) for secondary crops can calculated :

NFR = Etc – Re
= 3.28 – 0.34
= 2.94 mm/ day

After counting the NFR value of the pattern, the plant obtained NFR Max per year. Next, determine irrigation water needs with the use of Efficiency total irrigation 0.65 and its calculation like the following: (Setiadi & Muhaemin, 2018)

Irrigation water requirement = NFR / (Efficiency x 8.64)
= 10.07 / (0.85 x 8.64)
= 1.37 l/sec/ha

Table 7. Irrigation Water Needs

GROUPS	**PADDY**	**0.85**
I	10.07	1.37
II	10.07	1.37
III	10.18	1.39
	SECONDARY CROPS	0.85
I	8.33	1.13
II	8.33	1.13
III	7.83	1.07

Source: Calculation Results, 2024

For calculation from every season, plants from 3 Groups can counted as follows:

a. Rice Field Water Requirements (Land Preparation)
KAS = “ a”(Land Preparation) x Area (ha)
= 2.49 x 316
= 787.74 l/sec/ha

b. Rice Field Water Requirements (Planting, Planting, and Cooking Period)
KAS = “a” x Area (ha)
= 1.81 x 316
= 572.61 l/dt/ha

Table 8. KAS 3 Planting Season 3 Groups

Planting Season	Month		Flow Requirement (m3/ second)	Availability Flow (m3/ sec)
MT I	November	I	990.86	1603.04
		II	995.51	2176.52
	December	I	1534.34	4244,20
		II	1327.59	2861.71
	January	I	1327.59	3032.94
		II	1327.59	4687.75
	February	I	1327.59	4981.40
		II	1327.59	4493.23
MT II	Maret	I	1316.66	5452.18
		II	1367.88	3186,18
	April	I	1377.45	3555.63
		II	1293.07	3166.85
	Mei	I	1293.07	2470,11
		II	1293.07	2479,18
	June	I	1293.07	2484.49
		II	1293.07	1804,18
MT III	juli	I	1075.65	1656.04
		II	1226.26	1804,18
	Augustus	I	935.22	1769.21
		II	935.22	1804.18
	September	I	935.22	1769.21
		II	935.22	2178.20
	October	I	935.22	1482.36
		II	448.42	1740.12

Source: Calculation Results, 2024

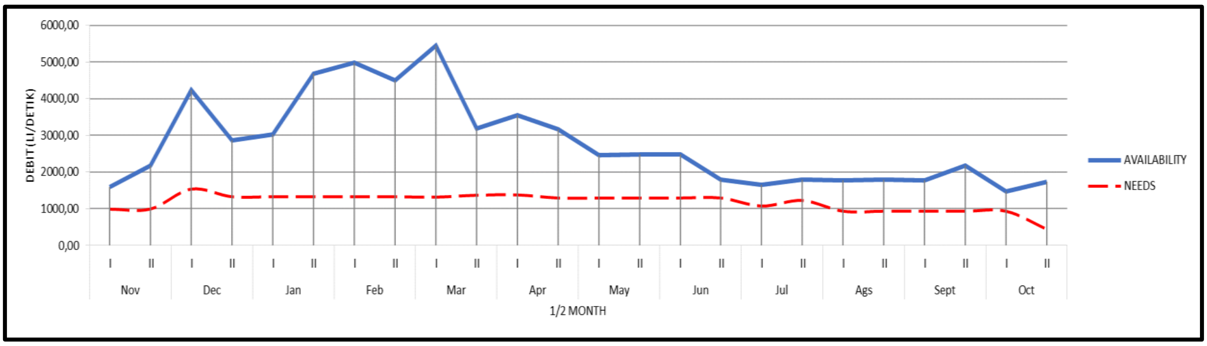

Figure 4. Water Balance Graph of Needs and Availability

6. Planting Patterns

The First Planting Season started in November, followed by the Irrigation Area Planting Pattern. Weir Third uses a planting pattern (Paddy-Paddy-secondary crops) (Khapid et al., 2020).

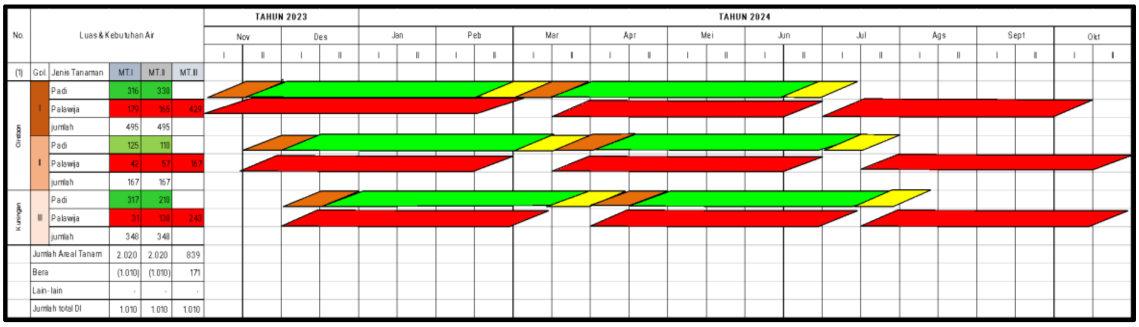

Figure 5. Planting Patterns of Irrigated Areas Weir Third

7. Conditions Network Irrigation

Table 9. Condition of DI Katiga Channel

Description	**Vol (Km)**	**Condition (Km)**				**Function (%)**			**Note**
		Good	Minor Damage	Moderate Damage	Severely Damaged	Good	Currently	Damaged	
Parent	0.81	0.4	0.13	0.27	-	51	49	0	Good
Secondary									
Katiga	2.15	0.3	0.61	0.65	0.6	12	59	30	Moderate Damage
Waru	4.46	0.8	1.04	1.41	1.2	17	55	28	Moderate Damage
Panambangan	2.23	-	0.39	0.67	1.2	0	48	53	Severely Damaged
Winduhaji	1.78	-	0.27	0.39	1.1	1	37	61	Severely Damaged
Amount	11.43	1.5	2.44	3.39	4.1	13	51	36	Moderate Damage
Average		0.4	0.49	0.68	1	16	50	34	Moderate Damage

Source: Calculation Results, 2024 (Sugiwanto et al., 2019)

Table 10. Condition of Buildings in Katiga

Building Description	**Vol (bh)**	**Condition (bh)**				**Function (%)**			**Note**
		Good	Minor Damage	Moderate Damage	Severely Damaged	Good	Currently	Damaged	

Main									
Weir	1	-	1	-	-	0	100	0	Good
Sluice	2	-	1	1	-	0	100	0	Good
Regulator									
For Tapping	2	-	2	-	-	0	100	0	Good
Tapping	18	-	2	9	7	0	61	39	Moderate Damage
Direct Tapping	42	-	7	8	27	0	36	64	Severely Damaged
Complement									
Sluice	8	-	-	8	-	0	100	0	Good
Measurement Building	26	-	-	18	8	0	69	31	Moderate Damage
Carrier Falls	13	1	4	7	1	8	84	8	Good
Gutter	1	1	-	-	-	100	0	0	Good
Tilted Ditch	2	-	1	1	-	0	100	0	Good
Side Spillway	8	-	4	4	-	0	100	0	Good
Drainer	6	-	-	6	-	0	100	0	Good
Supplement	4	-	1	3	-	0	100	0	Good
Bridge People	10	1	3	6	-	10	90	0	Good
Bridge Village	11	-	8	3	-	0	100	0	Good
Laundry	25	-	-	24	1	0	96	4	Good
Animal Bath	1	-	-	1	-	0	100	0	Good
Amount	180	3	34	99	44				
Average		1	3.09	7.07	8.8	7	85	9	Good

Source: Calculation Results, 2024

8. Management Staff Institutions Field

Table 12. Field Management Personnel

Channels and Management Staff	Personnel			Percentage (%)	
	Need	There is	Not enough	There is	Not enough
Sal.Parent (0.81)					

Irrigation Officer	1	1	0	100	0
POB	1	1	0	100	0
PPA	1	1	0	100	0
Secondary Sal (9.65)					
PPA	4	4	0	100	0
PPS	5	0	5	0	100
Amount	12	7	5	58	42

Source: Calculation Results, 2024

9. Actual Operational and Maintenance Needs Figures (AKNOP)

Table 13 Operational and Maintenance Costs at Katiga Dam

Year		2023	2024	2025
Operate		648,100,000	648,100,000	763.710.170
Swakelola	Routine	703.758.590	703.758.590	733.174.550
	Periodic	372.573.016	372.573.016	192.338.022
Contractual		777,536,695	777,536,695	997.389.117
rehabilitation		2,010,233,000	2,010,233,000	2,164,539,000
P3A		25,560,000	25,560,000	25,560,000
Coaching		50,620,000	50,620,000	50,620,000
Disaster Reserve (15%)		375.295.245	375.295.245	402,991,779
Amount		4,963,676,545	4,963,676,545	5,330,322,638

Source: Kalijaga-Cisanggarung Service Unit

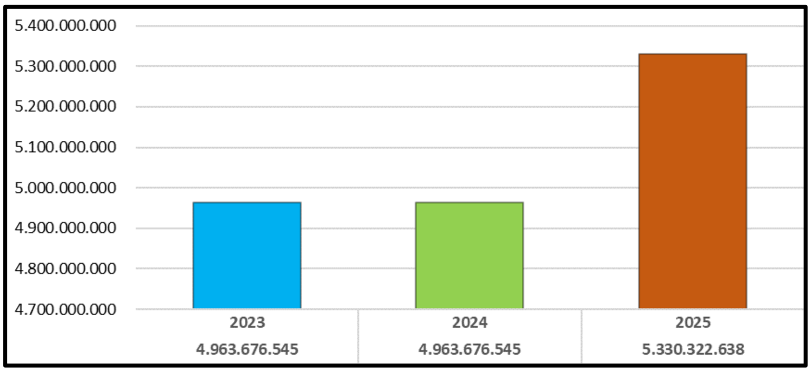

Figure 6 Graph of Needs Figures Real Operation and Maintenance

Conclusion

The result of the analysis calculation of rainfall rain area using the Paddy-Paddy-Secondary Crops, the comparison of the flow rate of water needed with the debit of Irrigation Area Availability Third, can conclude that the debit availability river is bigger from the debit requirement, with thus water needs in irrigation areas Weir Third all in all-sufficient.

From the results analysis condition of the irrigation network, namely with a good classification of 12%, moderate of 67%, and damage of 21%, it can be concluded that the condition of the irrigation network in the Katiga Dam irrigation area is slightly damaged. Then, for the number of management personnel available, only seven people, while the actual need is 12 people, indicating a shortage of power managers, namely five people, with a percentage of 42%, so that service to condition channel is not fulfilled enough. The AKNOP analysis shows that operational and maintenance costs in 2025 will increase from the previous year, so it can be said that budgeting for Operations and maintenance in irrigation areas Weir Third is not good enough.

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