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Analysis of Gegesic Divider Irrigation Door Opening 5 for Water Demand Efficiency

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ABSTRACT

Water resources management is critical in supporting sustainable agricultural development and ensuring food security. Efficient water use in irrigation systems is required to optimize crop growth and production and minimize water wastage. This study aims to analyze the opening of irrigation sluice gates at the Gegesik 5 distribution gate to improve water demand efficiency. The research methodology included field observation, data collection, and calculations to determine the optimal sluice gate opening based on water availability and crop water requirements. Factors such as rainfall, evapotranspiration, crop water requirements, and irrigation system efficiency were also considered. The results showed that the non-secondary door height was 5 cm, and the tertiary door opening was 10 cm. The highest percentage of water demand efficiency in the channel is in Bundermire 1 Ki Channel at 99.74%, which indicates that the use of water in the primary channel is quite efficient, the lowest percentage of water demand efficiency is in Gegesik Ki 1 Channel at 76.47%, in other channels, the efficiency level is obtained in Bundermire 2 Ki at 93.13%, in Bundermire 2 Ka at 77 26%, Bundermire 1 Ka at 87, 69%, Gegesik Ki 2 by 78.20% and Gegesik 5 channel by 94.90% so as to identify the actual water demand for various activities and apply water-saving technologies and methods by applying the sluice gate opening strategy, then this research has implications for the management of water resources in the study area can be optimized to contribute to sustainable agricultural practices and food security.

Keywords: Irrigation Door Opening, Water Demand Efficiency, Divider Door, Door Opening Height, Water Discharge.

INTRODUCTION

Water resources are vital for socio-economic growth, food production, public health and many other sectors. However, the sustainability of global water resources is currently facing serious threats due to population growth, water pollution, and a significant increase in demand (Juwono et al., 2022). Globally, about 2.2 billion people do not have access to clean water, and more than 4 billion people experience water scarcity for at least one month a year (Mawardi, 2014). This water crisis is expected to worsen in the future, as the world's population growth is projected to reach 9.7 billion by 2050 (Anwar, 2022).

The agricultural sector is the largest water user, with more than 70% of global freshwater use allocated to irrigation. However, water distribution efficiency in irrigation systems remains a major challenge. Water losses due to network leakage, evaporation, and suboptimal management have a direct impact on decreasing farmland productivity as well as water scarcity in certain regions (López-Lambraño et al., 2020). Therefore, the application of innovative technologies and strategies to improve water use efficiency is an urgent priority in addressing this global challenge.

Indonesia, as an agricultural country with the fourth largest population in the world, faces similar challenges. Based on a report by the Central Statistics Agency (BPS, *Badan Pusat Statistik*), around 81% of Indonesia's water resources are utilized for agricultural needs (Rhofita, 2022). However, irrigation efficiency in various regions is still low, with an average water loss rate reaching 30% due to suboptimal management (Panagopoulos et al., 2014). One of the areas experiencing water distribution constraints is Cirebon Regency, West Java, where the Gegesik irrigation system is one of the main sources of irrigation for agricultural areas.

In Gegesik, inaccuracies in sluice gate operations often lead to problems such as water shortages downstream and water wastage upstream. This phenomenon is not only detrimental to local farmers, but also exacerbates the sustainability challenges of water resource management. The Gegesik 5 distribution sluice gate is one of the important elements in the irrigation network in the area. This sluice gate is tasked with regulating the flow of water to the various irrigation channels to ensure equitable distribution. However, in practice, setting the door opening is often not based on a measured water demand analysis, leading to inefficiencies. The lack of monitoring and technical evaluation of sluice gate operations further exacerbates this situation.

Research related to irrigation efficiency has been carried out by various parties. (Bunganaen et al., 2020) highlighted the importance of implementing automatic regulation technology on sluice gates to reduce water loss in irrigation networks. (Rao, 2023) found that a distribution system based on water demand analytics can increase efficiency by up to 25%. Meanwhile, (Pareke & Sh, 2020) studied the effect of sluice gate management on farmland productivity and emphasized the importance of a data-driven approach to water flow regulation.

However, specific research analyzing the efficiency of sluice gate openings in the Gegesik area, especially at distribution gates such as Gegesik 5, is still very limited. This creates a research gap that needs to be urgently addressed. Water scarcity and inefficient water use in the agricultural sector pose a real threat to the sustainability of the national food system (Alfian, 2023). Considering that Cirebon Regency is one of the main rice barns in West Java, optimizing irrigation management in this region is very important. Water use efficiency through proper regulation of sluice gate openings can help reduce the impact of water shortages, increase agricultural yields, and support food security in a sustainable manner.

This study offers an innovative approach by integrating data-driven water demand analysis on the sluice gate opening setting of Gegesik 5. Unlike previous research that tends to focus on technological or design aspects of irrigation systems in general, this study specifically examines the relationship between sluice gate opening settings and water demand efficiency at the local level. Thus, this study is expected to provide practical guidance for irrigation managers in optimizing water distribution.

Based on the above background, this research aims to analyze the opening of the Gegesik 5 distribution sluice gate in meeting water demand efficiently, with a focus on evaluating the existing conditions of sluice gate operation, identifying factors that affect water distribution efficiency, and developing a strategy for setting openings based on water demand analysis. With this approach, the research is expected to provide significant benefits, both for irrigation managers, farmers, and policy makers. Irrigation managers can utilize data-based guidance to improve water management efficiency, while farmers will benefit through optimal water distribution that supports land productivity.

RESEARCH METHOD

This study uses a qualitative approach with a case study method for the type of data using qualitative data, including primary data collected through field observations and discussions with related parties and secondary data obtained from written sources such as books, journals, research reports, and statistical data from associated agencies such as the Central Statistics Agency (BPS), the Irrigation Office, or the River Basin Center. To make it easier to know the order of the final project, the author presents the methodology of the work in the form of a flow diagram as follows:

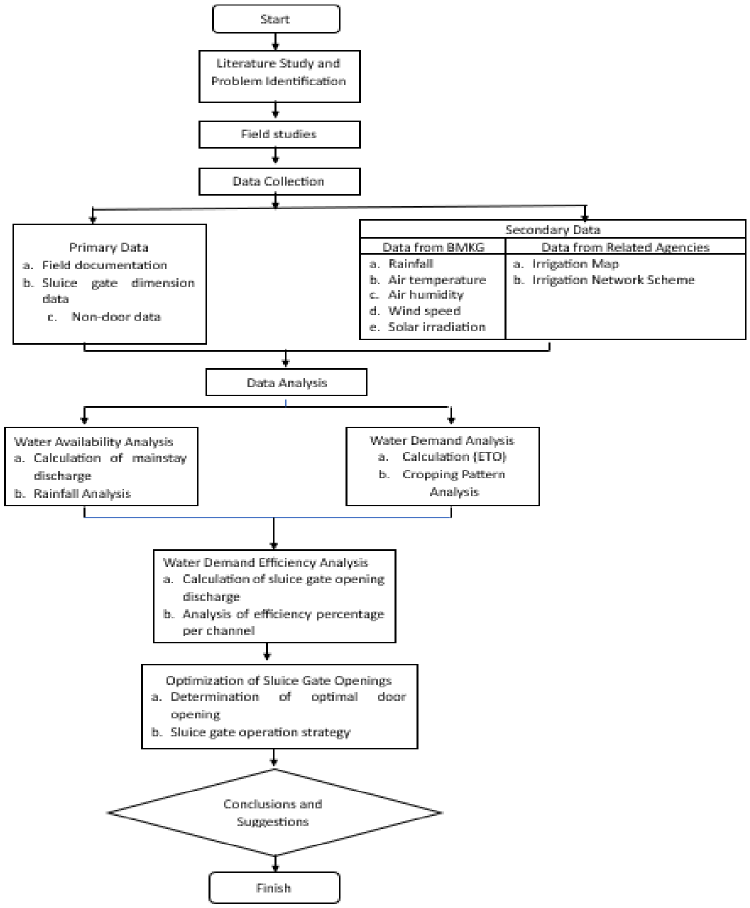

Figure 1. Research Flowchart

The research was located in the Gegesik irrigation area, Gegesik Village, Gegesik District, Cirebon Regency, West Java Province, Indonesia. The Gegesik Main Canal serves an irrigation area of 8,933 hectares spread across five sub-districts and 34 villages in Cirebon Regency.

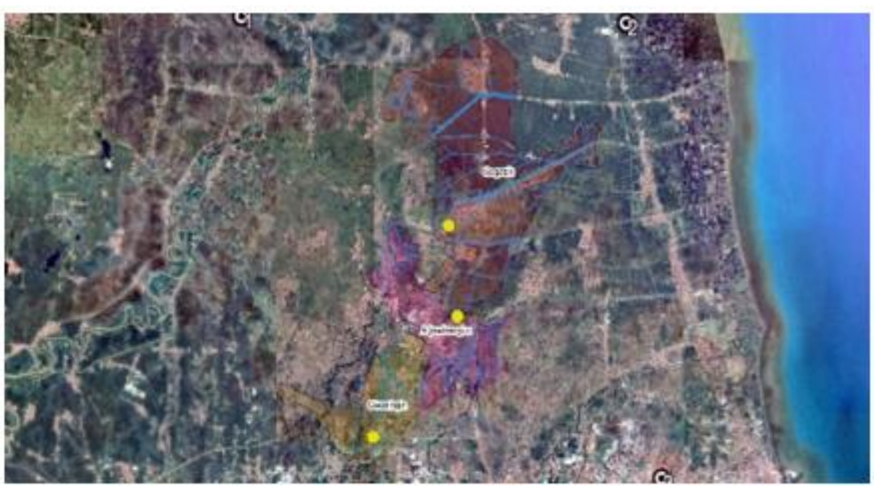

Figure 2. Map of the Research Location

Source: Google Earth

RESULT AND DISCUSSION

For this Planning and analysis of the availability and demand of irrigation water, rainfall data was obtained from the Meteorology, Climatology, and Geophysics Agency (BMKG) located in Cirebon. The first step to securing evaporation data is calculating rainfall data (sorted rainfall data), air humidity, wind speed, solar irradiation, and air temperature. Here are the Gegesic Climatology data:

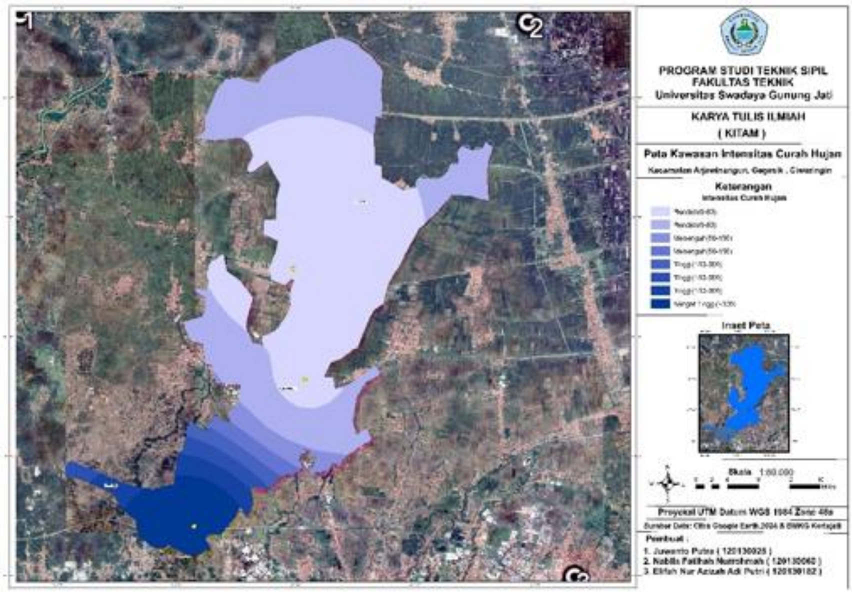

Figure 3. Map of Rainfall Distribution Area

NO	TAHUN	JAN I	JAN II	FEB I	FEB II	MAR I	MAR II	APR I	APR II	MEI I	MEI II	JUN I	JUN II	JUL I	JUL II	AGU I	AGU II	SEP I	SEP II	OKT I	OKT II	NOV I	NOV II	DES I	DES II
1	2010	30.00	23.50	51.20	22.31	25.13	25.75	30.67	26.27	27.60	16.81	19.60	10.73	18.27	16.25	30.27	17.75	7.00	11.33	17.20	13.50	14.53	13.93	20.40	22.69
2	2011	19.07	17.38	24.33	22.08	21.07	16.44	22.33	22.67	12.93	14.75	18.67	9.67	14.67	16.19	16.67	10.38	14.07	20.47	9.53	9.44	13.00	10.33	13.87	19.38
3	2012	16.47	11.94	16.47	20.38	16.87	14.94	15.53	15.20	10.47	9.19	14.75	9.07	13.73	7.81	6.80	9.81	13.93	7.33	7.60	9.00	9.27	9.87	13.00	16.88
4	2013	17.47	8.75	16.07	18.85	15.20	15.75	12.33	16.27	8.87	8.75	14.33	8.73	10.73	7.75	5.60	6.44	15.27	6.67	6.93	7.75	8.33	9.73	12.60	16.19
5	2014	16.93	8.50	13.93	17.29	13.60	12.88	12.27	14.40	7.47	6.06	13.47	8.67	9.00	7.38	4.53	4.81	5.20	6.00	6.87	5.81	8.07	9.53	11.00	13.75
6	2015	14.93	8.38	12.27	15.46	12.00	12.50	11.20	14.13	5.40	5.94	7.47	5.60	4.93	6.56	4.20	4.19	4.00	2.87	5.60	5.69	6.93	8.47	8.07	13.44
7	2016	14.73	8.38	11.20	15.12	11.57	9.06	7.60	11.87	4.27	4.50	6.40	5.00	4.80	6.06	2.13	3.06	3.00	2.80	5.67	5.31	6.07	8.07	6.47	12.31
8	2017	13.80	8.25	10.60	8.15	8.33	8.44	7.53	4.93	2.20	3.31	5.07	5.00	4.07	0.56	1.53	3.06	2.67	2.67	4.62	5.13	4.80	6.47	6.35	7.38
9	2018	12.47	8.19	4.33	5.93	4.27	8.31	6.81	4.47	2.07	3.06	2.93	4.93	4.00	0.00	0.00	1.50	0.00	2.07	3.60	3.88	2.93	5.38	4.33	7.31
10	2019	7.13	3.13	3.93	2.77	2.93	6.94	5.93	4.20	1.73	2.56	0.13	4.80	1.33	0.00	0.00	0.00	0.00	1.47	3.20	1.38	1.33	4.60	4.20	7.00
11	2020	7.00	2.93	3.60	0.15	0.73	6.81	4.00	4.20	1.33	1.38	0.00	1.20	0.00	0.00	0.00	0.00	0.00	0.93	2.93	0.38	0.00	2.47	2.00	6.31
12	2021	2.87	2.31	0.67	0.00	0.47	1.75	2.40	2.73	0.93	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	4.69
13	2022	1.33	0.63	0.00	0.00	0.13	0.00	2.33	2.73	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.31
14	2023	0.00	0.00	0.00	0.00	0.00	0.00	2.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RATA-RATA/BULAN		12.59	8.02	12.19	10.61	9.48	9.83	10.21	10.85	6.14	5.45	7.34	5.24	6.11	4.90	5.41	4.36	4.51	4.62	5.31	4.80	5.38	6.35	7.31	10.83
JUMLAH/BULAN		176.20	112.25	170.60	148.48	132.70	137.56	142.95	151.93	85.93	76.31	102.82	73.33	85.53	68.56	75.73	61.00	63.13	64.73	74.36	67.19	75.27	88.84	102.28	151.62
CH Efektif		0.13	0.11	0.03	0.00	0.02	0.08	0.11	0.13	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.22
Q50 (Liter/detik)		13800.00	8250.00	10600.00	8153.85	8333.33	8487.50	7533.33	4933.33	2200.00	3312.50	5066.67	5000.00	4066.67	562.50	1533.33	3062.50	2666.67	2666.67	4623.81	5125.00	4799.02	6466.67	6345.91	7375.00
Q80 (Liter/detik)		2866.67	2312.50	666.67	0.00	466.67	1750.00	2400.00	2733.33	933.33	0.00	0.00	133.33	0.00	0.00	0.00	0.00	0.00	133.33	0.00	0.00	0.00	0.00	0.00	4687.50
JH		15.00	16.00	14.00	14.00	15.00	16.00	15.00	15.00	15.00	16.00	15.00	15.00	15.00	16.00	15.00	16.00	15.00	15.00	15.00	16.00	15.00	15.00	15.00	16.00
Q 50 (Liter/detik/ha)		1.64	0.98	1.26	0.97	0.99	1.00	0.90	0.59	0.26	0.39	0.60	0.59	0.48	0.07	0.18	0.36	0.32	0.32	0.55	0.61	0.57	0.77	0.75	0.88
Q 80 (Liter/detik/ha)		0.34	0.27	0.08	0.00	0.06	0.21	0.29	0.33	0.11	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.56
Re = 70% . R80 (mm/bulan)		2.01	1.62	0.47	0.00	0.33	1.25	1.66	1.91	0.65	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	3.28
Re = 70% . R80 (mm/hari)		0.07	0.05	0.02	0.00	0.01	0.04	0.06	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11
Re = 50% . R80 (mm/bulan)		1.43	1.16	0.33	0.00	0.23	0.88	1.20	1.37	0.47	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	2.34
Re = 50% . R80 (mm/hari)		0.05	0.04	0.01	0.00	0.01	0.03	0.04	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08
Volume		925.54	553.31	710.92	546.66	558.90	566.89	505.25	330.87	147.55	222.16	339.81	335.34	272.74	37.73	102.84	205.40	178.85	178.85	310.11	343.72	321.86	433.71	425.61	494.63
Q (m3/s)		1.64	0.98	1.26	0.97	0.99	1.00	0.90	0.59	0.26	0.39	0.60	0.59	0.48	0.07	0.18	0.36	0.32	0.32	0.55	0.61	0.57	0.77	0.75	0.88

Figure 4. Recapitulation of Rainfall That Has Been Sequenced Gegesic

Source: BMKG Jatiwangi Station

NO	TAHUN	BULAN																							
		JANUARI		FEBUARI		MARET		APRIL		MEI		JUNI		JULI		AGUSTUS		SEPTEMBER		OKTOBER		NOVEMBER		DESEMBER	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	2010	1.20	1.25	1.17	1.07	1.14	0.93	0.60	0.67	1.25	0.90	0.93	1.28	1.21	1.46	1.91	1.43	1.33	1.23	1.35	1.07	0.90	0.93	1.07	1.00
2	2011	2.97	4.21	3.59	3.00	3.00	2.19	2.34	2.04	2.15	2.61	3.74	3.63	3.80	4.34	4.03	4.41	4.17	4.23	3.67	4.24	3.41	2.73	2.97	2.73
3	2012	2.93	3.17	4.05	2.80	2.76	3.91	2.89	3.37	3.23	3.30	3.53	3.91	3.67	3.20	3.63	4.43	4.03	4.13	4.03	4.27	4.04	3.53	2.66	2.83
4	2013	2.73	3.30	2.73	3.63	3.00	2.73	2.56	3.37	3.60	2.11	2.57	2.90	3.33	3.82	4.22	4.49	4.05	4.25	4.13	4.35	3.76	3.62	2.91	3.11
5	2014	2.99	3.97	3.97	2.19	2.57	3.00	3.10	2.47	3.27	3.37	3.43	3.67	4.25	3.57	5.13	4.23	4.43	4.93	4.33	4.56	4.37	3.07	2.87	3.05
6	2015	3.63	3.17	2.43	2.56	2.77	2.52	2.29	2.29	2.63	2.90	3.64	3.63	5.04	4.37	5.35	4.37	4.91	5.29	5.23	5.07	3.53	3.50	2.73	3.43
7	2016	2.72	2.79	2.81	2.68	2.63	2.55	2.69	3.03	2.80	1.81	1.09	0.89	1.43	1.07	1.41	1.59	2.06	2.11	1.81	1.83	1.62	1.41	1.57	2.11
8	2017	1.83	1.73	2.54	1.88	1.80	1.67	1.60	1.43	1.84	2.06	1.95	2.29	2.05	2.45	2.41	2.25	2.76	2.61	2.07	1.95	1.73	1.45	1.35	1.58
9	2018	1.63	1.61	2.17	2.25	1.62	1.59	1.67	2.09	1.92	2.44	2.02	2.29	2.32	2.19	2.29	2.51	2.62	2.71	2.71	2.77	2.26	2.05	1.80	1.57
10	2019	1.74	1.75	2.20	1.57	1.71	1.94	1.94	1.57	2.20	1.97	2.21	2.07	2.16	2.45	2.37	2.57	3.00	2.75	3.17	2.93	2.63	1.98	2.26	1.65
11	2020	1.49	2.25	1.92	1.73	1.88	2.03	1.58	1.27	1.72	2.04	2.13	1.88	2.17	2.21	2.33	2.27	2.89	3.03	2.89	2.66	2.41	1.73	2.35	1.71
12	2021	2.01	1.89	2.09	2.74	2.63	2.66	2.03	1.84	2.01	2.09	2.27	2.19	2.17	1.91	2.41	2.39	3.11	2.48	2.64	2.83	2.27	2.14	1.84	1.71
13	2022	2.30	1.93	1.95	2.60	2.41	2.24	2.49	2.11	1.60	1.71	2.04	2.41	2.01	2.30	2.39	2.73	2.53	3.20	2.44	2.61	2.39	2.66	2.12	2.02
14	2023	3.41	2.57	2.92	3.26	3.35	1.91	1.99	2.13	2.05	2.32	2.71	2.87	2.61	2.59	3.32	3.43	3.39	3.37	3.34	3.93	2.89	2.47	2.57	2.17
JUMLAH/BULAN		33.60	35.49	36.54	34.05	33.26	31.89	29.95	29.87	32.47	31.63	34.27	35.91	38.32	37.93	43.19	43.11	45.09	46.31	43.62	45.08	36.21	33.28	31.05	30.87
Rata-Rata (knot)		2.40	2.53	2.61	2.43	2.38	2.28	2.14	2.13	2.32	2.26	2.45	2.56	2.74	2.71	3.08	3.08	3.26	3.31	3.13	3.22	2.73	2.38	2.22	2.21
Rata-Rata (km/jam)		4.44	4.69	4.83	4.50	4.40	4.22	3.96	3.95	4.30	4.18	4.53	4.75	5.07	5.02	5.71	5.70	6.04	6.13	5.80	5.96	5.05	4.40	4.11	4.08
Rata-Rata (km/hari)		106.68	112.67	116.01	108.11	105.60	101.24	95.10	94.82	103.10	100.41	108.79	114.00	121.66	120.41	137.11	136.88	145.05	147.04	139.12	143.12	121.30	105.66	98.59	98.02
Rata-Rata (m/detik)		1.23	1.30	1.34	1.25	1.22	1.17	1.10	1.10	1.19	1.16	1.26	1.32	1.41	1.39	1.59	1.58	1.68	1.70	1.61	1.66	1.40	1.22	1.14	1.13
1 knot =		1.85	km/jam																						

Figure 5. Recapitulation of Gusty Wind Speed

Source: BMKG Jatiwangi Station

NO	TAHUN	BULAN																							
		JANUARI		FEBUARI		MARET		APRIL		MEI		JUNI		JULI		AGUSTUS		SEPTEMBER		OKTOBER		NOVEMBER		DESEMBER	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	2010	84.64	86.73	84.73	85.73	83.20	85.20	85.73	87.53	87.33	87.53	85.67	83.33	89.07	87.80	89.93	87.40	87.27	90.00	87.60	86.27	87.40	88.13	88.07	85.60
2	2011	82.07	87.73	85.80	83.27	80.27	89.00	88.20	70.33	73.27	83.20	79.60	84.80	82.87	77.73	85.13	84.67	81.60	83.53	88.20	84.20	86.67	85.20	84.47	85.60
3	2012	87.87	84.33	82.13	87.60	76.47	89.00	81.47	77.47	77.67	74.40	83.47	89.33	85.60	85.93	79.53	86.67	87.27	86.60	88.13	89.20	83.20	83.53	85.00	86.47
4	2013	88.20	82.73	87.00	90.67	84.07	84.00	76.93	72.07	84.73	84.27	74.20	85.13	81.87	82.47	81.60	88.73	91.40	87.00	89.53	90.33	89.73	82.87	88.60	92.60
5	2014	86.20	83.93	87.27	85.53	87.00	83.27	82.40	77.40	79.67	77.93	89.33	70.40	83.40	90.20	68.53	75.87	88.73	90.47	87.00	91.40	83.20	87.00	81.67	72.00
6	2015	76.20	81.93	88.87	83.47	91.00	84.20	84.13	65.40	79.53	86.07	71.13	77.80	85.20	85.67	84.33	86.67	89.67	88.20	91.00	82.40	86.67	79.40	83.13	81.00
7	2016	78.47	83.80	81.53	81.47	80.80	82.13	82.20	78.73	80.53	78.20	80.40	84.00	81.60	81.53	80.93	83.20	83.00	82.93	83.33	84.80	83.67	82.27	79.40	79.00
8	2017	80.33	79.40	78.33	82.40	81.87	80.93	82.67	73.80	78.47	82.07	74.93	79.73	80.47	78.93	80.07	83.13	82.33	81.53	82.07	82.40	83.47	77.07	79.80	81.13
9	2018	79.07	76.93	78.07	78.13	79.07	77.93	77.20	72.93	78.73	75.73	74.73	80.00	83.93	82.53	77.73	76.73	75.60	75.40	79.60	76.67	80.80	79.20	81.80	72.73
10	2019	74.73	71.20	77.27	82.27	84.20	83.13	82.47	83.67	81.73	86.20	85.27	86.27	80.60	83.33	82.53	82.13	85.27	79.40	77.20	78.13	80.80	78.93	74.07	76.40
11	2020	73.67	76.80	77.93	86.73	75.00	78.87	81.33	77.27	81.73	80.00	86.20	78.00	76.47	81.47	76.33	78.73	80.73	76.00	77.93	70.67	72.07	71.13	72.87	76.87
12	2021	78.53	78.07	78.33	73.47	85.00	82.33	85.67	84.13	87.20	81.67	77.53	82.93	84.33	78.40	78.07	80.20	80.40	74.20	77.33	76.07	74.67	78.27	75.53	74.60
13	2022	78.27	76.60	76.00	76.20	83.53	83.47	77.73	81.67	85.67	76.93	81.53	85.93	84.53	79.60	81.07	77.33	76.53	81.40	73.53	72.73	71.93	76.33	71.47	71.53
14	2023	71.47	79.53	85.33	82.73	82.60	82.60	84.67	82.67	84.80	82.60	83.07	82.47	85.87	83.87	83.73	84.53	81.47	81.60	82.60	84.53	81.67	83.33	82.80	83.15
RATA-RATA/BULAN		79.99	80.84	82.04	81.56	82.58	83.29	82.41	77.50	81.50	79.84	79.08	82.15	83.27	82.82	80.82	82.59	83.60	82.73	83.29	82.13	81.80	80.90	80.69	79.92
JUMLAH/BULAN		1119.91	1131.73	1148.60	1141.87	1156.07	1166.07	1153.80	1085.07	1141.07	1117.80	1107.07	1150.13	1165.80	1159.47	1131.53	1156.20	1170.27	1158.27	1166.07	1149.80	1145.13	1132.67	1129.67	1118.89

Figure 6. Gectic Air Humidity Recapitulation

Source: BMKG Jatiwangi Station

NO	TAHUN	BULAN																							
		JANUARI		FEBUARI		MARET		APRIL		MEI		JUNI		JULI		AGUSTUS		SEPTEMBER		OKTOBER		NOVEMBER		DESEMBER	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	2010	3.21	3.39	4.16	5.03	5.12	4.35	5.06	5.09	4.95	5.57	4.15	4.49	3.81	3.73	5.39	5.81	5.30	3.43	4.61	4.34	3.04	4.39	3.53	2.67
2	2011	3.01	1.96	2.51	4.80	2.52	3.66	3.60	3.77	3.81	5.65	5.13	7.85	5.78	5.47	7.35	6.69	7.01	6.13	6.44	5.32	3.99	3.38	4.29	3.58
3	2012	3.85	3.07	2.93	4.78	3.13	2.49	5.03	5.61	5.93	5.58	6.37	4.77	7.26	6.45	6.55	7.72	7.39	7.70	6.66	6.39	5.58	3.29	4.39	4.07
4	2013	3.21	3.25	2.67	5.39	3.12	4.88	4.83	4.92	4.89	5.31	4.35	3.59	5.65	4.96	4.85	6.25	7.85	7.55	7.23	7.57	6.43	4.94	3.74	3.49
5	2014	3.17	3.06	1.78	2.66	3.31	4.16	5.19	6.03	5.05	6.23	6.89	6.07	5.54	3.43	6.32	6.37	7.19	7.00	8.13	8.49	7.19	6.86	4.05	4.34
6	2015	3.56	3.19	4.89	3.60	3.89	4.16	4.07	4.29	4.73	4.66	6.99	7.83	7.38	7.42	7.47	8.11	7.47	6.89	8.08	8.43	8.18	8.10	6.87	6.39
7	2016	4.63	4.21	5.83	3.72	2.54	4.35	4.02	4.73	5.04	5.64	5.75	5.05	5.87	4.85	6.77	5.61	6.69	4.35	4.45	5.79	3.86	3.67	4.05	3.72
8	2017	3.34	5.02	3.73	4.44	3.03	1.46	2.41	4.87	3.86	5.51	5.71	7.05	5.60	6.00	4.65	4.93	7.33	4.98	8.17	8.45	6.05	6.32	6.30	4.49
9	2018	2.74	3.52	3.36	2.95	3.38	2.47	5.09	5.07	3.81	5.97	6.07	7.63	6.16	7.87	5.88	8.28	8.14	7.33	7.21	7.77	7.67	8.49	6.17	3.31
10	2019	5.53	4.30	4.00	6.18	2.65	3.75	6.31	3.20	3.96	6.21	5.21	6.19	8.30	7.47	7.59	8.47	8.22	8.57	8.43	8.53	8.70	8.60	8.76	7.23
11	2020	7.27	5.44	4.86	3.99	5.10	3.95	3.75	3.52	4.50	5.33	5.93	4.89	5.36	5.79	7.52	6.39	5.79	8.10	6.41	8.11	8.23	7.13	6.19	4.85
12	2021	6.33	4.81	3.03	4.55	2.22	2.12	2.89	1.57	3.97	5.58	4.99	7.67	6.29	5.94	6.05	4.58	6.34	6.88	6.83	6.57	6.03	6.81	7.15	4.66
13	2022	3.63	3.73	4.22	4.17	4.65	3.71	3.43	2.83	3.37	4.90	5.31	6.35	5.09	4.26	5.32	3.81	6.92	4.95	7.30	6.80	5.23	6.12	5.15	2.68
14	2023	4.74	4.82	1.98	0.92	2.33	5.77	3.55	5.55	5.95	5.47	7.39	5.58	6.94	6.47	7.54	8.29	7.51	8.39	8.81	8.50	8.55	5.55	3.97	6.48
RATA-RATA/BULAN		4.15	3.82	3.57	4.09	3.39	3.66	4.23	4.35	4.56	5.54	5.73	6.06	6.07	5.72	6.40	6.52	7.07	6.59	7.05	7.18	6.36	5.98	5.33	4.45
JUMLAH/BULAN		58.11	53.48	49.96	57.19	47.40	51.27	59.25	60.86	63.83	77.62	80.26	84.83	85.03	80.11	89.60	91.30	98.97	92.26	98.75	100.55	89.08	83.65	74.62	62.31

Figure 7. Gegesic Solar Irradiation Recapitulation

Source: BMKG Jatiwangi Station

NO	TAHUN	BULAN																							
		JANUARI		FEBUARI		MARET		APRIL		MEI		JUNI		JULI		AGUSTUS		SEPTEMBER		OKTOBER		NOVEMBER		DESEMBER	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	2010	26.70	2631	26.99	2737	27.19	27.07	27.77	28.21	2739	28.01	2767	27.20	27.09	26.97	27.87	2764	27.29	2761	28.25	27.59	27.35	27.40	2653	26.61
2	2011	27.20	2642	26.45	2711	26.61	26.75	27.21	26.77	2716	27.50	2741	26.46	26.96	27.34	27.05	2741	28.17	2873	28.96	29.79	28.58	27.21	2781	27.49
3	2012	26.99	2665	26.80	2687	27.07	26.88	27.27	27.72	2809	27.70	2788	27.05	27.37	27.65	27.21	2754	28.07	2812	29.33	29.77	29.61	29.31	2809	27.37
4	2013	26.87	2703	26.35	2673	26.81	27.03	27.45	27.78	2766	28.03	2717	27.22	27.47	26.10	26.64	2716	27.29	2785	28.63	29.21	29.59	28.92	2740	27.44
5	2014	26.41	2784	28.57	2890	28.90	28.90	28.90	28.90	2890	28.90	2890	28.90	28.90	28.90	28.90	2890	28.90	2890	28.84	28.85	29.29	28.90	2890	28.90
6	2015	28.90	2842	28.73	2724	26.00	26.51	26.67	27.73	2772	28.74	2828	27.45	27.71	27.33	27.21	2732	27.79	2834	28.51	29.14	29.27	29.78	2927	29.32
7	2016	27.89	2761	26.77	2700	27.22	28.11	28.07	28.27	2831	28.45	2752	27.23	27.89	27.42	27.87	2808	28.09	2769	26.97	27.65	27.35	27.68	2713	27.45
8	2017	27.54	2654	26.69	2659	26.65	27.01	27.14	27.73	2756	28.12	2765	27.62	27.42	27.79	27.85	2805	28.33	2924	28.46	28.82	28.22	27.20	2745	26.98
9	2018	26.99	2731	26.15	2657	26.62	26.90	28.29	27.67	2821	27.88	2826	27.21	27.28	27.41	27.70	2796	28.65	2903	30.00	29.89	28.38	28.44	2791	27.69
10	2019	27.65	2709	26.74	2745	27.25	27.13	27.71	28.16	2837	28.57	2848	27.34	27.52	27.56	27.34	2803	28.19	2834	29.85	30.34	30.19	30.40	2885	27.81
11	2020	27.70	2729	26.91	2711	27.43	27.53	28.09	28.25	2850	27.96	2811	27.49	27.66	27.64	28.04	2871	29.03	2880	28.81	27.19	28.82	27.35	2669	26.89
12	2021	26.47	2599	26.42	2629	26.34	27.46	27.78	28.39	2844	28.30	2807	26.81	27.58	27.77	28.43	2805	28.47	2879	29.45	28.65	27.43	26.81	2721	27.15
13	2022	27.03	2723	26.74	2665	26.81	27.52	27.53	27.90	2826	27.55	2730	26.61	27.75	27.30	27.97	2799	27.97	2866	27.89	27.37	27.70	27.37	2695	27.21
14	2023	26.50	2649	26.32	2740	27.20	27.91	28.53	28.52	2861	27.87	2827	27.70	27.95	27.68	28.09	2894	28.72	3070	30.85	30.27	28.80	28.94	2876	27.80
RATA-RATA/BULAN		27.20	2701	26.90	2709	27.01	27.34	27.76	28.00	2808	28.11	2793	27.32	27.61	27.49	27.72	2798	28.28	2863	28.91	28.89	28.60	28.27	2778	27.58
JUMLAH/BULAN		380.84	378.19	376.63	379.26	378.11	382.71	388.61	392.02	393.17	393.59	390.97	382.49	386.54	384.85	388.13	391.79	395.97	400.80	404.76	404.53	400.39	395.71	388.93	386.09

Figure 8. Gectic Air Temperature Recapitulation

Source: BMKG Jatiwangi Station

From the results of the field survey, the total area of BGS5 rice fields was obtained, which is 564 ha, and the mainstay discharge was obtained as follows:

Table 1. Mainstay Debit

It	Moon	Q(m3/s)
1	January l	1.64
2	January ll	0.96
3	February I	1.26
4	February II	0.97
5	March I	0.99
6	March II	1
7	April I	0.90
8	April II	0.59
9	May I	0.26
10	May II	0.39
11	June I	0.60
12	June II	0.59
13	July I	0.48
14	July II	0.07
15	August I	0.18
16	August II	0.32
17	September I	0.33
18	September II	0.32
19	October I	0.55
20	October II	0.61
21	November I	0.57
22	November II	0.77
23	December I	0.75
24	December ll	0.88

Source: Calculation Results

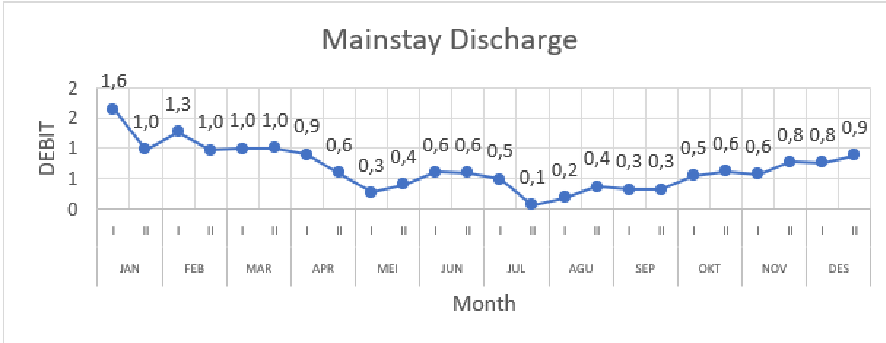

Figure 9. Mainstay Debit

Source: Calculation Results

After obtaining the necessary data, such as the practical rainfall value for R-80, the average air humidity every month, the average solar irradiation every month, the average wind speed, and the average air temperature, to find the evaporation value, it is calculated using the evapotranspiration potential (ET0) calculation formula using the Penman Modification (Equation) method because of the existence of supporting data. The following is the process of determining the ET0 value:

Some methods to calculate the amount of evaporation include the Penman formula, namely:

ETo = C x Eto* .... (1)

ETo* = w. (0,75Rs – Rn1) + {(1-w) . f(u) . (ea-ed)} .... (2)

No.	Perhitungan	Bulan																							
		Jan		Feb		Mar		Apr		Mei		Jun		Jul		Agu		Sep		Okt		Nov		Des	
		I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	Temperatur Udara Rata-Rata (°C)	27.20	27.01	26.90	27.09	27.01	27.34	27.76	28.00	28.08	28.11	27.93	27.32	27.61	27.49	27.72	27.98	28.28	28.63	28.91	28.89	28.60	28.27	27.78	27.58
2	Kelembaban Relatif (RH) %	79.99	80.84	82.04	81.56	82.58	83.29	82.41	77.50	81.50	79.84	79.08	82.15	83.27	82.82	80.82	82.59	83.80	82.73	83.29	82.13	81.80	80.90	80.69	79.92
3	Penyinaran Matahari (n/N)	4.15	3.82	3.57	4.09	3.39	3.66	4.23	4.35	4.56	5.54	5.73	6.06	6.07	5.72	6.40	6.52	7.07	6.59	7.05	7.18	6.36	5.98	5.33	4.45
4	Kecepatan Angin "U" (km/hari)	106.68	112.67	116.01	108.11	105.60	101.24	95.10	94.82	103.10	100.41	108.79	114.00	121.66	120.41	137.11	136.88	145.05	147.04	139.12	143.12	121.30	105.66	98.59	98.02
5	Kecepatan Angin "U" (m/detik)	1.23	1.30	1.34	1.25	1.22	1.17	1.10	1.10	1.19	1.16	1.26	1.32	1.41	1.39	1.59	1.58	1.68	1.70	1.61	1.66	1.40	1.22	1.14	1.13
6	Kecepatan Angin "U" (km/jam)	4.44	4.69	4.83	4.50	4.40	4.22	3.96	3.95	4.30	4.18	4.53	4.75	5.07	5.02	5.71	5.70	6.04	6.13	5.80	5.96	5.05	4.40	4.11	4.08
7	Fu = 0,27 x (1+U/100) (m/detik)	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27
8	ea (Tabel 5)	36.09	35.66	35.46	35.88	35.66	36.30	37.37	37.81	38.03	38.03	37.59	36.30	36.94	36.72	37.16	37.81	38.48	39.14	39.84	39.84	39.14	38.48	37.37	36.94
9	ed = ea x RH/100	28.87	28.83	29.09	29.26	29.45	30.23	30.80	29.30	31.00	30.36	29.72	29.82	30.76	30.41	30.03	31.23	32.24	32.38	33.18	32.72	32.01	31.13	30.15	29.52
10	ea - ed	7.22	6.83	6.37	6.61	6.21	6.06	6.57	8.51	7.03	7.67	7.87	6.48	6.18	6.31	7.12	6.58	6.23	6.76	6.66	7.12	7.13	7.35	7.22	7.42
11	W (Tabel 5)	0.77	0.77	0.76	0.77	0.77	0.77	0.77	0.78	0.78	0.78	0.77	0.77	0.77	0.77	0.77	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.77	0.77
12	1-W	0.23	0.24	0.24	0.23	0.24	0.23	0.23	0.23	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23
13	Ra (Tabel 10) ; 7,5° LS	16.03	16.03	16.08	16.08	15.53	15.53	14.48	14.48	13.18	13.18	12.45	12.45	12.80	12.80	13.78	13.78	14.93	14.93	15.78	15.78	15.95	15.95	15.93	15.93
14	Rs = (0,25 + 0,54 n/N) x Ra	4.37	4.34	4.33	4.37	4.17	4.19	3.95	3.96	3.62	3.69	3.50	3.52	3.62	3.60	3.92	3.93	4.30	4.26	4.54	4.56	4.54	4.50	4.44	4.36
15	Rns = (1-ax) x Rs mm/hari, (a = 0,25)	3.27	3.25	3.25	3.28	3.12	3.14	2.96	2.97	2.71	2.77	2.62	2.64	2.71	2.70	2.94	2.95	3.23	3.20	3.41	3.42	3.40	3.38	3.33	3.27
16	Ft = Tk (Tabel 5)	16.14	16.10	16.09	16.12	16.10	16.16	16.26	16.30	16.32	16.32	16.28	16.16	16.22	16.20	16.24	16.30	16.36	16.42	16.48	16.48	16.42	16.36	16.26	16.22
17	F(ed) = 0,34 - (0,044 . √Ed)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.10	0.10
18	F(n/N) = 0,1 + (0,9 . n/N)	0.14	0.13	0.13	0.14	0.13	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.15	0.14
19	Rn_1 = Ft . F(ed) . F(n/N)	0.23	0.22	0.22	0.22	0.21	0.21	0.22	0.23	0.22	0.24	0.25	0.25	0.24	0.24	0.25	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.23
20	Rn = Rns - Rn_1 (mm/hari)	3.04	3.03	3.03	3.06	2.91	2.93	2.75	2.74	2.49	2.53	2.38	2.39	2.47	2.46	2.69	2.70	2.98	2.96	3.18	3.18	3.17	3.14	3.09	3.04
21	U_{day} / U_{night} (Tabel 16)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
22	C = F . (Rhmax . Uday / Unight)	1.10	1.10	1.10	1.10	1.10	1.10	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	1.00	1.00	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
23	Eto* = w (0,75Rs - Rn1) + (1-W)(Fu)(ea-ed)	2.79	2.76	2.72	2.76	2.63	2.63	2.53	2.64	2.37	2.43	2.33	2.25	2.29	2.29	2.52	2.50	2.70	2.72	2.88	2.91	2.90	2.89	2.84	2.81
24	ETo (mm/hari)	3.07	3.03	3.00	3.04	2.89	2.90	2.28	2.38	2.13	2.19	2.09	2.02	2.07	2.06	2.52	2.50	2.97	2.99	3.17	3.20	3.19	3.18	3.12	3.09
25	ETo (mm/bulan)	46.12	48.50	41.96	42.56	43.33	46.38	34.16	35.70	31.95	35.00	31.39	32.36	30.98	30.91	37.80	40.02	44.58	44.88	47.58	51.27	47.86	50.82	46.83	49.47

Figure 10. Recapitulation of Evaporation Calculation

Source: Calculation Results

	Uraian			Nop		Des		Jan		Feb		Mar		Apr		Mei		Jun		Jul		Agust		Sep		Okt	
				I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	Jumlah Hari			15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16
				PL				Padi				PL				Padi							padi				
2	ET_0 (Penman)	mm/hari		3.19	3.18	3.12	3.09	3.07	3.03	3.00	3.04	2.89	2.90	2.28	2.38	2.13	2.19	2.09	2.02	2.07	2.06	2.52	2.50	2.97	2.99	3.17	3.20
3	P	mm/hari		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Water Layer RelPacement/Pergantian Lapisan Air																										
4	WLR1	WLR	WLR						3.33		3.00							3.33		3.00							
5	WLR2	50.00	45.00					3.33		3.00							3.33		3.00								
6	WLR3						3.33		3.00							3.33		3.00									
7	WLR						1.11	1.11	2.11	1.00	1.00					1.11	1.11	2.11	1.00	1.00							
	Koefisien Tanaman																										
8	C1			PL	PL	PL	1.20	1.27	1.33	1.30	1.30	0.00	PL	PL	PL	1.10	1.10	1.05	1.05	0.95	1.1	1.1	1.05	1.05	0.95	0	0
9	C2			PL	PL	1.20	1.27	1.33	1.30	1.30	0.00		PL	PL	1.20	1.27	1.33	1.30	1.30	0.5	0.59	0.96	0.96	1.05	1.02	0.95	
10	C3			PL	1.20	1.27	1.33	1.30	1.30	0.00			PL	1.20	1.27	1.33	1.30	1.30	0.5	0.59	0.96	0.96	1.05	1.02	0.95		
11	Kc			-	-	-	1.27	1.30	1.31	0.87	0.43	0.00	-	-	-	1.23	1.24	1.22	0.95	0.68	0.88	1.01	1.02	1.24	0.97	0.32	0.00
12	$ET_c = ET_0 \times Kc$						3.92	4.00	3.97	2.62	1.32	0.00				2.63	2.72	2.55	1.92	1.40	1.82	2.54	2.55	3.29	2.91	1.02	0.00
	Penyiapan Lahan (LP)/Land Preparation (LP)																										
13	$Eo = 1{,}1 \times Eto$			3.51	3.49	3.48							3.188	2.505	2.618												
14	$M = Eo + P$			5.51	5.49	5.48							5.188	4.505	4.618												
15	$k = MT/S$	215	195	1.15	1.15	1.14							1.197	1.040	1.066												
16	e^k	45	--> Kerbau	3.17	3.16	3.12							3.31	2.83	2.90												
17	$IR = M.e^k/(e^k-1)$			8.05	8.04	8.00							7.43	6.97	7.04												
	CH Efektif																										
18	Re	mm/hari		0.00	0.00	0.00	0.22	0.13	0.11	0.03	0.00	0.02	0.08	0.11	0.13	0.24	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	Kebutuhan Bersih Air di Sawah																										
19	Kebutuhan Air Total	mm/hari		8.05	8.04	8.00	7.03	7.11	8.08	5.62	4.32	2.00	6.90	6.83	6.78	5.74	5.83	6.66	4.92	4.42	3.82	2.54	2.55	3.29	2.91	1.02	0.00
20	NFR	mm/hari		8.05	8.04	8.00	6.81	6.97	7.97	5.57	4.32	1.98	6.82	6.72	6.66	5.69	5.83	6.66	4.92	4.42	3.82	2.54	2.55	3.29	2.91	1.02	0.00
21	NFR	l/detik/ha		0.93	0.93	0.93	0.79	0.81	0.92	0.64	0.50	0.23	0.79	0.78	0.77	0.66	0.67	0.77	0.57	0.51	0.44	0.29	0.30	0.36	0.34	0.12	0.00
	Kebutuhan Air Irigasi																										
22	DR EFISIENSI TOTAL =	0.65		0.93	0.93	0.93	0.79	0.81	0.92	0.64	0.50	0.23	0.79	0.78	0.77	0.66	0.67	0.77	0.57	0.51	0.44	0.29	0.30	0.36	0.34	0.12	0.00

Figure 11. MT 1 Rice Irrigation Water Needs

Source: Calculation Results

	Uraian			Nop		Des		Jan		Feb		Mar		Apr		Mei		Jun		Jul		Agust		Sep		Okt	
				I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II	I	II
1	Jumlah Hari			15	16	14	14	15	16	15	15	15	16	15	15	15	16	15	16	15	15	15	16	15	15	15	16
					PL					Padi				PL					Padi						Palawija(Jagung)		
2	ET_0 (Penman)	mm/hari		3.19	3.18	3.12	3.09	3.07	3.03	3.00	3.04	2.89	2.90	2.28	2.38	2.13	2.19	2.09	2.02	2.07	2.06	2.52	2.50	2.97	2.99	3.17	3.20
3	P	mm/hari		2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	Water Layer RelPacement/Pergantian Lapisan Air																										
4	WLR1	WLR	WLR						3.33		3.00							3.33		3.00							
5	WLR2	50.00	45.00					3.33		3.00							3.33		3.00								
6	WLR3						3.33		3.00							3.33		3.00									
7	WLR						1.11	1.11	2.11	1.00	1.00					1.11	1.11	2.11	1.00	1.00							
	Koefisien Tanaman																										
8	C1			PL	PL	PL	1.20	1.27	1.33	1.30	1.30	0.00	PL	PL	PL	1.10	1.10	1.05	1.05	0.95	0.5	0.59	0.96	0.96	1.05	1.02	0.95
9	C2			PL	PL	1.20	1.27	1.33	1.30	1.30	0.00		PL	PL	1.10	1.10	1.05	1.05	0.95	0.5	0.59	0.96	0.96	1.05	1.02	0.95	
10	C3			PL	1.20	1.27	1.33	1.30	1.30	0.00			PL	1.10	1.10	1.05	1.05	0.95	0.5	0.59	0.96	0.96	1.05	1.02	0.95		
11	Kc			-	-	-	1.27	1.30	1.31	0.87	0.43	0.00	-	-	-	1.08	1.07	1.02	0.83	0.68	0.68	0.84	0.99	1.01	1.01	0.66	0.32
12	$ET_c = ET_0 \times Kc$						3.92	4.00	3.97	2.60	1.32	0.00				2.31	2.33	2.13	1.69	1.40	1.41	2.11	2.48	3.00	3.01	2.08	1.01
	Penyiapan Lahan (LP)/Land Preparation (LP)																										
13	$Eo = 1{,}1 \times Eto$			3.51	3.49	3.43							3.188	2.505	2.618												
14	$M = Eo + P$			5.51	5.49	5.43							5.188	4.505	4.618												
15	$k = MT/S$ $S =$	215	195	1.15	1.15	1.14							1.197	1.040	1.066												
16	e^k $T =$	45	--> Kerbau	3.17	3.16	3.12							3.31	2.83	2.90												
17	$IR = M.e^k/(e^k-1)$			8.05	8.04	8.00							7.43	6.97	7.04												
	CH Efektif																										
18	Re	mm/hari		0.00	0.00	0.00	0.22	0.13	0.11	0.03	0.00	0.02	0.08	0.11	0.13	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	Kebutuhan Bersih Air di Sawah																										
19	Kebutuhan Air Total	mm/hari		8.05	8.04	8.00	7.03	7.11	8.08	5.60	4.32	2.00	6.90	6.83	6.78	5.42	5.44	6.24	4.69	4.40	3.41	2.11	2.48	3.00	3.01	2.08	1.01
20	NFR	mm/hari		8.05	8.04	8.00	6.81	6.97	7.97	5.57	4.32	1.98	6.82	6.72	6.66	5.37	5.44	6.24	4.68	4.40	3.41	2.11	2.48	3.00	3.01	2.08	1.01
21	NFR	l/detik/ha		0.93	0.93	0.93	0.79	0.81	0.92	0.64	0.50	0.23	0.79	0.78	0.77	0.62	0.63	0.72	0.54	0.51	0.39	0.24	0.29	0.35	0.35	0.24	0.12
	Kebutuhan Air Irigasi																										
22	DR EFISIENSI TOTAL =	0.65		0.93	0.93	0.93	0.79	0.81	0.92	0.64	0.50	0.23	0.79	0.78	0.77	0.62	0.63	0.72	0.54	0.51	0.39	0.24	0.29	0.35	0.35	0.24	0.12

Figure 12. MT 2 Rice Irrigation Water Needs

Source: Calculation Results

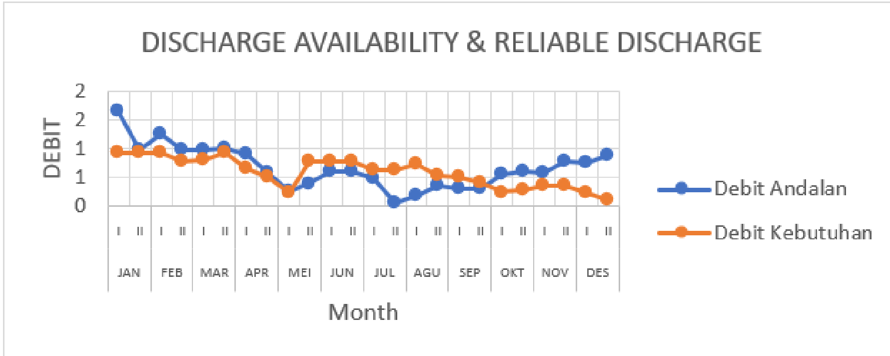

Figure 13. Availability Debit & Flagship Debit MT1 Planting Pattern

Source: Calculation Results

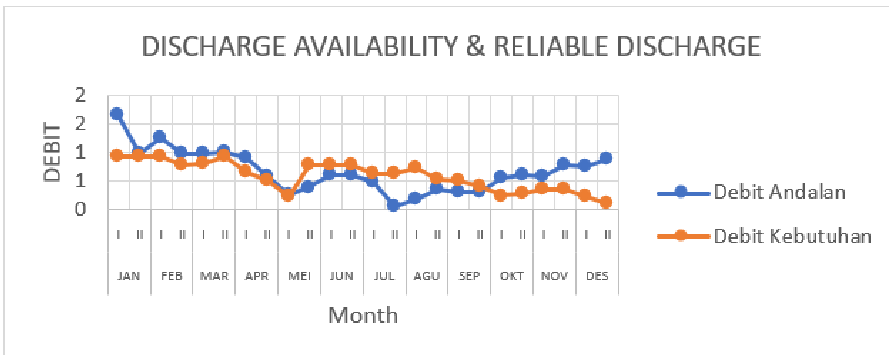

Figure 14. Availability Debit & Flagship Debit MT2 Planting Pattern

Source: Calculation Results

After all the necessary data, the last step is to calculate the water discharge planning for non-irrigation gates in BGs 5, divided into seven irrigation canals, of which one primary outlet and six tertiary channels are in the BGs5 area. When the divider door is rotated, there is 1 time of rotation of 5 cm high for the tertiary channel, 1 time of rotation as high as 10 cm for the primary channel.

Table 2. Door Dimension Size

No.	Lokasi	Dimensi Pintu	Jumlah
1	B.MR. 1a Ki + 1a Ka	B. 0,60m H. 0,80 m	2 Unit
2	B.MR. 1 Ki + 1a Ka	B. 0,60m H. 0,80 m	2 Unit
3	B.MR. 2a Ki 2a + 2a Ka	B. 0,60m H. 0,80 m	2 Unit
4	B.MR. 2 Ki	B. 0,60m H. 0,80 m	1 Unit
5	B.MR. 2 tg	B. 0,65m H. 0,80 m	1 Unit

Source: Observation Results

To calculate the measured discharge interval using the formula:

1.71 x b x (h1.25) .... (3)

Table 3. Percentage of Water Demand Efficiency at Bundermire 2 Ki

Channel Name	**Standard Discharge**	**Measured Discharge Interval**	**Water Efficiency Percentage**
	m3/sec	**{1,71 x b x (h1,25)}**	**100%**
		m3/sec	
S.Bundermire 2 Ki	0.06	0.01	93.13
		0.03	
		0.06	

Source: Calculation Results

Table 4. Percentage of Water Demand Efficiency at Bundermire 2 Ka

Channel Name	**Standard Discharge**	**Measured Discharge Interval**	**Water Efficiency Percentage**
	m3/sec	**{1,71 x b x (h1,25)}**	**100%**
		m3/sec	
S.Bundermire 2 Ka	0.07	0.01	77.26
		0.03	
		0.06	
		0.09	
		0.13	

Source: Calculation Results

Table 5. Percentage of Water Demand Efficiency at 1 Ki Bundermire

Channel Name	**Standard Discharge**	**Measured Discharge Interval**	**Water Efficiency Percentage**
	m3/sec	**{1,71 x b x (h1,25)}**	**100%**
		m3/sec	
S.Bundermire 1 Ki	0.21	0.01	99.74
		0.03	
		0.06	
		0.09	
		0.13	
		0.17	
		0.21	

Source: Calculation Results

Table 6. Percentage of Water Demand Efficiency at Bundermire 1 Ka

Channel Name	**Standard Discharge**	**Measured Discharge Interval**	**Water Efficiency Percentage**
	m3/sec	**{1,71 x b x (h1,25)}**	**100%**
		m3/sec	
S.Bundermire 1 Ka	0.04	0.01	87.69
		0.03	

Source: Calculation Results

Table 7. Percentage of Water Demand Efficiency at Gegesik Ki 1

Channel Name	Standard Discharge	Measured Discharge Interval	Water Efficiency Percentage
	m3/sec	{1,71 x b x (h1,25)}	100%
		m3/sec	
T.Gegesik Ki 1	0.12	0.01	76.47
		0.03	
		0.06	
		0.09	

Source: Calculation Results

Table 8. Percentage of Water Demand Efficiency at Gegesik Ki 2

Channel Name	Standard Discharge	Measured Discharge Interval	Water Efficiency Percentage
	m3/sec	{1,71 x b x (h1,25)}	100%
		m3/sec	
T.Gegesik Ki 2	0.16	0.01	78.20
		0.03	
		0.06	
		0.09	
		0.13	

Source: Calculation Results

Table 9. Percentage of Water Demand Efficiency at Gegesik 5

Channel Name	Standard Discharge	Measured Discharge Interval	Water Efficiency Percentage
	m3/sec	{1,71 x b x (h1,25)}	100%
		m3/sec	
P.Gegesik 5	1	0.04	94.90
		0.01	
		0.18	
		0.28	
		0.39	
		0.52	
		0.65	
		0.80	
		0.95	

Source: Calculation Results

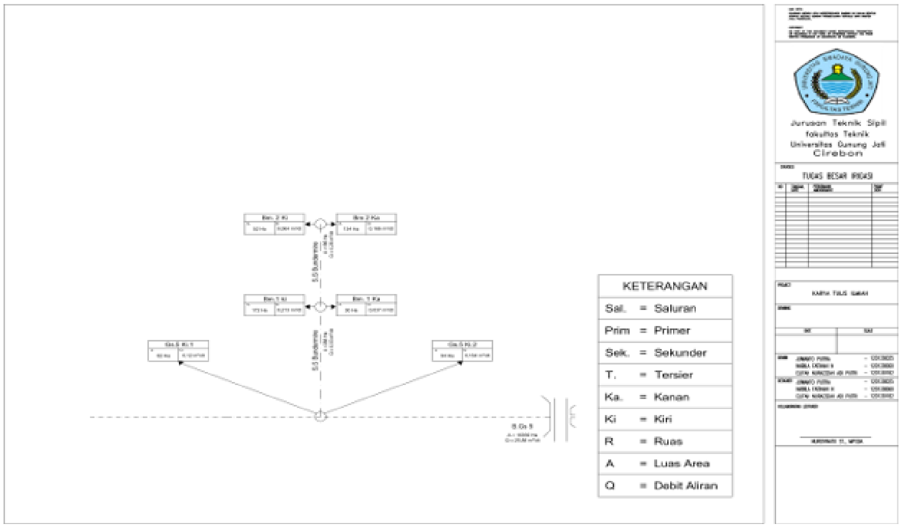

Figure 15. BGs 5 Irrigation Scheme

Source: Calculation Results

The study's results show that efforts to improve water efficiency can be carried out by identifying the actual water needs for various activities and applying technology and economical methods. Interval discharge must not exceed the standard discharge.

Determining the percentage of water demand efficiency at each door opening can be calculated using the following formula:

$$\text{Percentage of water efficiency } = \times \ 100\% \frac{Debit\ standar}{Debit\ Interval}$$

Discussion

Optimizing the use of water resources in irrigation systems is essential to support food security and environmental sustainability (Sutrisno & Hamdani, 2019). Previous research highlights various approaches to improve water use efficiency. For example, research by (Fery, 2023) highlighted the importance of automatic setting technology on sluice gates to reduce water loss in irrigation networks. This approach not only reduces wastage but also ensures equitable distribution of water to farmlands in need. In the context of Gegesik, data-driven sluice gate settings can help address similar challenges, including water distribution imbalances that occur between upstream and downstream.

A study by (Ouassanouan et al., 2022) showed that water demand-based analysis can increase efficiency by up to 25%. The study integrated climate data such as rainfall, air temperature and wind speed to calculate water demand with more precision. This is relevant to the approach used in the Gegesik 5 study, where climate data such as evaporation and rainfall are used to calculate water demand and availability, so that irrigation gate opening settings can be adjusted to actual needs.

Another study by (Hasibuan, 2023) emphasized the importance of a data-driven approach in water flow management to improve agricultural land productivity. In the context of Gegesik 5 irrigation, this research is relevant because proper sluice gate settings not only improve water use efficiency but also reduce the impact of water shortages that often occur during the dry season. The research also underscores the need for periodic technical evaluation of sluice gates to ensure their optimal operation.

In Indonesia, research by (Juwono et al., 2022) shows that about 30% of water resources are lost due to sub-optimal management. This reflects the challenges faced by the Gegesik irrigation system, where water losses in the primary and secondary canals are significant. Therefore, the sluice gate opening-based approach studied in this research can be a model to reduce water losses and improve the efficiency of irrigation systems, especially in areas prone to water shortages (Laswono, 2016).

CONCLUSION

The conclusion of this study shows that climatological data processing in the Gegesik 5 water division area results in potential discharge planning and land requirements for the first quarter (January-May) that can meet irrigation needs. However, in the second quarter (May-July), irrigation needs cannot be met because it enters the dry season. Processing data of sluice gate opening discharge in Bundermire irrigation canal showed variation of discharge in different areas, such as T.Bundermire 2 Ki by 0.60 m^3/sec, T.Bundermire 2 Ka by 0.13 m^3/sec, and P.Gegesik by 0.95 m^3/sec. The rotation system is applied during the water shortage period in May, where sluice gate settings must be in accordance with the plan and maintained based on the SOP (standard operating procedure) to prevent damage or technical problems.

This research makes an important contribution in improving water use efficiency in local irrigation systems through a data-driven approach in setting sluice gate openings. In the future, the findings can be used to develop adaptive irrigation strategies that consider climate variability, such as increasingly erratic rainfall patterns and dry seasons. In addition, this research also opens up opportunities for the integration of sensor-based technologies and automation in sluice gate management, which can improve precision in water distribution and reduce water resource losses in irrigation networks. This is expected to support agricultural sustainability, especially in areas that depend on irrigation systems to meet local and national food needs.

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