DEVOTION
Journal of Research and Community Service
Volume 6, Number 1, January 2025
e-ISSN: 2797-6068 and p-ISSN: 2777-0915

Analysis of Irrigation Water Requirements In The Secondary Channel of Rentang Irrigation Area

Erhan Anugrah, Mustafa El Faris, Nurdiyanto
Universitas Swadaya Gunung Jati, Indonesia
anugraherhan@gmail.com, nurdiantomjl@gmail.com

KEYWORDS
irrigation; water; agricultural water planning

ABSTRACT
Effective management and planning of irrigation systems critically depend on accurately understanding the overall irrigation water requirements. This study aims to evaluate and project the irrigation water needs in the secondary channel of BSD 1, located in the Rentang Irrigation Area, Majalengka Regency, which serves an irrigation area of 620 hectares and is supplied by the Jatigede Dam and Cimanuk River. Factors such as effective rainfall, water layer changes, seepage, consumptive use, and land preparation are considered in determining water needs. The research employs the kp-01 concept, allowing manual calculations to determine irrigation requirements. Results indicate that irrigation water is necessary starting in early November due to the rice planting pattern. The manual calculations reveal a maximum irrigation water requirement of 1.55 m^3 per second during the second period of May and a minimum requirement of 0.06 m^3 per second during the second period of December. The findings highlight the importance of understanding seasonal variations and optimizing water resource allocation to ensure efficient irrigation practices. This study concludes that adopting precise calculation methods like kp-01 is essential for sustainable irrigation management and can serve as a reference for similar agricultural planning efforts in other regions.

INTRODUCTION

Water is the main resource needed in daily life, such as for ponds, fisheries, agriculture, and other activities. Since inefficient use and utilization of water is common, it is very important to maintain a balance between the supply and the amount of water needed (Priyonugroho, 2014). The main step in determining the total amount of water needed for irrigation is by planning and managing the irrigation system. When calculating the water volume requirement, the level of rainfall quantity and groundwater contribution are also taken into account as part of meeting the water needs for plants, the amount of water lost, and the fulfillment of evaporation demand (Suyono & Takeda, 2003).

A series of activities related to providing water for the purposes of agriculture, plantations, fields, and rice fields are called irrigation. The main focus of this research is to build facilities that allow water to be distributed regularly to the rice fields and to discharge excess water that is no longer needed for agricultural activities (Sudjarwadi, 1979).

When calculating water volume needs, the level of rainfall quantity and groundwater contribution are also taken into account as part of meeting water needs for plants, the amount of water lost, and meeting evaporation demand.

Along with population growth, the need for water for agriculture also increases. The increase in food demand must be balanced with this increase (Ardiansa et al., 2021). Efforts implemented to overcome the increase in water demand are by managing water resources as effectively and efficiently as possible (Sumpala, 2022). The method implemented to calculate the amount of water needed in irrigation is by implementing potential evapotranspiration, including intake discharge, water *intake* needs, irrigation water needed for rice plants, effective rainfall, consumptive water needs, clean water needs in sawh, and land preparation (Andita & Lipu, 2020).

Agricultural success is also influenced by land irrigation management and water availability. The purpose of processing climatological and hydrological data for irrigation management planning is to determine the amount of water available and needed for agricultural land. In addition, to achieve compatibility between irrigation water that can be used today and appropriate water use patterns (LATIFAH, 2022).

Therefore, an analysis of water needs needs to be carried out. The purpose of this study is to determine the amount of water discharge needed to irrigate the irrigation area of the BSD 1 secondary canal range which has an area of 620 ha. It is hoped that this research will be useful as a guide and research for policy determination in relevant agencies (Akhirul et al., 2020).

Research Location

The Implementation of this research is in Cibeber village, located in Sukagumiwang District, Indramayu Regency, West Java.

Figure 1. Research location

Source: google earth

Water is a fundamental resource critical to various aspects of daily life, including agriculture, aquaculture, and household use. In the context of irrigation, efficient water management plays a vital role in ensuring agricultural productivity and sustainability. Inefficient utilization of water resources often results in wastage and mismanagement, necessitating an emphasis on effective planning and management strategies. Determining the precise irrigation water requirements is a foundational step in this process, considering factors such as rainfall, evaporation, and groundwater contributions, which influence the overall water balance in agricultural areas.

Irrigation systems aim to facilitate consistent water distribution to agricultural lands, ensuring crops receive adequate moisture for optimal growth. With population growth driving increased demand for food and water, sustainable irrigation management becomes indispensable. Methods such as evapotranspiration calculations, land preparation water needs, and crop-specific irrigation requirements are critical components of effective water resource allocation, especially in regions reliant on seasonal rainfall patterns.

In Indonesia, irrigation management is pivotal for food security, particularly in regions with large agricultural outputs like Majalengka Regency. Understanding the hydrological and climatological characteristics of these areas is essential for aligning water supply with demand. This research focuses on the secondary channel of the BSD 1 Rentang Irrigation Area, serving 620 hectares of agricultural land. The use of tools like the kp-01 concept facilitates precise manual calculations, allowing for a detailed assessment of irrigation water needs.

Seasonal variations significantly influence irrigation requirements. For instance, during the dry season, irrigation water demand increases as rainfall declines, whereas the rainy season reduces dependency on irrigation due to natural precipitation. Addressing these fluctuations through data-driven irrigation planning ensures efficient water use and minimizes wastage. Accurate projections of water requirements can mitigate risks associated with water scarcity or surplus, enhancing agricultural resilience.

Irrigation is not only a technical endeavor but also a socio-economic necessity, as it directly impacts food production and rural livelihoods. Ensuring sustainable water use through efficient irrigation management supports broader development goals, including poverty reduction and environmental conservation. Consequently, adopting reliable calculation methods, such as the kp-01 concept, is imperative for optimizing water resource use in agricultural areas.

This research is urgent due to the increasing pressure on water resources driven by population growth, urbanization, and climate variability. In regions like Majalengka Regency, where agriculture is a primary livelihood, ensuring efficient irrigation water management is critical for sustaining crop production and meeting food security needs. Addressing these challenges proactively can prevent potential conflicts over water allocation and support long-term agricultural sustainability.

Despite the importance of irrigation water management, existing studies often lack a comprehensive analysis of manual calculation methods like the kp-01 concept in secondary irrigation channels. While modern technologies and models have been applied in some regions, limited attention has been given to integrating these methods with local practices in Indonesia. This research addresses the gap by providing detailed insights into the application of kp-01 for assessing irrigation water requirements in the BSD 1 secondary channel.

The novelty of this research lies in its application of the kp-01 concept to manually calculate irrigation water requirements, offering a practical approach tailored to the specific conditions of the Rentang Irrigation Area. By incorporating factors such as effective rainfall, land preparation, and consumptive use, this study provides a comprehensive framework for managing irrigation water needs, particularly in regions where advanced technological solutions may not be accessible.

The primary objective of this study is to evaluate and project the irrigation water requirements for the BSD 1 secondary channel, ensuring efficient resource utilization and sustainable agricultural practices. The findings benefit policymakers by providing data-driven recommendations for irrigation planning, support farmers in optimizing water use, and contribute to academic research by advancing methodologies for manual irrigation water calculations. Ultimately, this research aims to enhance the sustainability and resilience of agricultural systems in Indonesia.

RESEARCH METHOD

Quantitative research is carried out to produce facts based on data and measurement results. The focus is on numerical data that can be processed and analyzed. The drafting process includes administrative and licensing arrangements, as well as the determination of related agencies to obtain data and information (Nurmansyah et al., 2024). Field observations are carried out to calibrate the calculation results and ensure consistency with field conditions. This data includes primary data from direct measurements and secondary data from the Cimanuk-Cisanggarung River Region Center agency. The following data were collected and applied in the calculation of water requirements for secondary channels of the Bsd 1 Range Irrigation Area:

1. Irrigation network layout/schema
2. Climatology data
3. Rainfall data

RESEARCH ANALYSIS STAGE

The stages in analyzing the data include:

1. Climatological analysis

Since the data collected supports Penman Monteith's approach, the data is used to calculate the evapotranspiration value of irrigation areas.

2. Rainfall analysis

- Every month it calculates the average rainfall by implementing the algebraic averaging technique since the last 10 years.

Calculate the effective rainfall of R80. ($= R_{80}\,\frac{m}{n+1}$ m = x (n+1)).R_{80}

Conducting effective rainfall calculations for rice. (Rice Re = (X 0.7)/ observation period)R_{80}

3. Water needs analysis

- Land tillage

Calculate the amount of water needed throughout the land preparation process. Using formula (KP-01) : IR = Me^{k} / (– 1)e^{k}

- Consumptive use

Calculate the amount of water needed by plants or plant consumptive plants. This formula is used to determine consumptive use, namely: = $ET_c K_c$ . .ET_o

- Percolation

  Conducting an analysis of the irrigation area related to the determination of the location power value by referring to the provisions of the table:

No.	Macam tanah	Perlokasi (mm/hari)
1.	*Sandy loam*	3-6
2.	*Loam*	2-3
3.	*clay*	1-2

Source: Soemarto, 1987

- Water layer replacement

  Replace the water layer according to the needs and is usually done twice if there is no replacement schedule. Each replacement is 50 mm (3.3 mm/day over a period of 2 weeks) for 4 to 8 weeks after transplantation (Bumbungan et al., 2023).

- Plant water needs

  a. Calculate the need for clean water in rice fields. (NFR= ET_C + P + WLR – Re)

  b. Calculate the need for irrigation water (IR) for rice. (IR=)$\frac{NFR}{e}$)

- Retrieving water needs from the source

  The amount of water required for irrigation divided by the efficiency of water extraction is known as the retrieval requirement. (DR=$\frac{IR}{8,46}$))

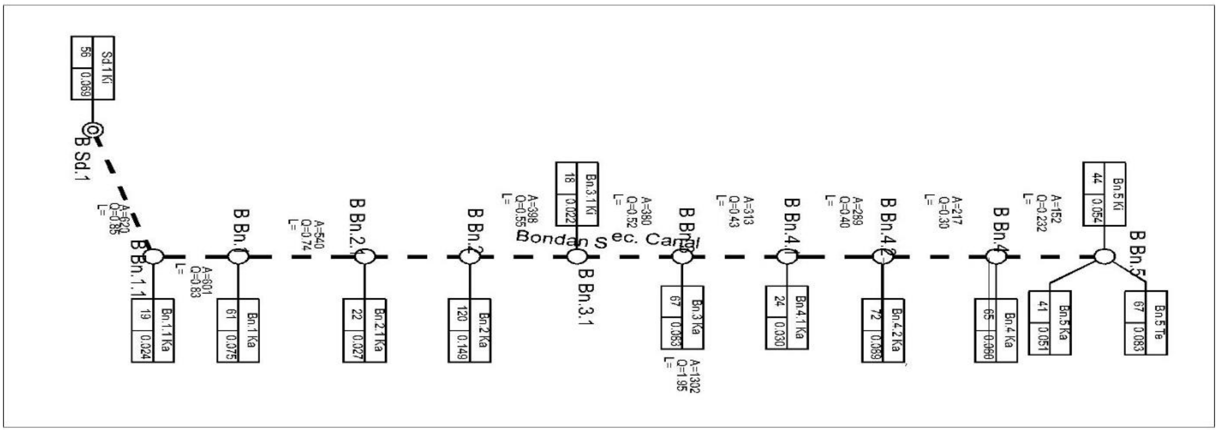

Figure 2. Irrigation network scheme of bsd 1

RESULTS AND DISCUSSION

Water availability

from the results of the survey in the field, the total area of BSD1 rice fields is 620 ha and the main discharge is obtained as follows:

Table 1 Water availability

Month	Periode	Stock
Nov	1	0.935
Nov	2	0.862
Dec	1	0.918
Dec	2	0.919
Jan	1	0.354
Jan	2	0.310
Feb	1	0.385
Feb	2	0.613
Mar	1	0.659
Mar	2	0.764
Apr	1	0.645
Apr	2	0.450
May	1	0.323
May	2	0.287
Jun	1	0.754
Jun	2	0.748
Jul	1	0.695
Jul	2	0.847
Aug	1	0.834
Aug	2	0.787
Sep	1	0.873
Sep	2	0.676
Oct	1	0.529
Oct	2	0.788

Evapotranspiration Analysis

Evapotranspiration that occurs when there is enough water (from irrigation or participation) to support optimal development is known as potential evapotranspiration. On the other hand, true evapotranspiration refers to evaporation that occurs while maintaining the existence of water (Wiyono, 2000).

Data on temperature, solar irradiation, air humidity and wind speed are secondary data obtained from the Irrigation Modernization Project (RIMP) Range Work Specifications, then calculated using the Penman-Monteith method obtained from January to December (Aronggear et al., 2019).

Table 2 Results of evapotranspiration calculation

Month	Suhu (°C)	Wind Speed (km/day))	RH (%)	Irradiation Duration (%)	Air Pressure (+1000 mb)	es (kPa)	es-ea (kPa)	Δ (kPa/°C)	λ (MJ/kg)	γ (kPa/°C)
Jan	26.50	2.20	86.5	4.90	10.64	3.46	0.47	0.204	2.44	0.068
Feb	26.40	2.00	89.7	4.60	10.64	3.44	0.35	0.203	2.44	0.068
Mar	27.00	2.10	85.6	6.10	10.64	3.57	0.51	0.209	2.44	0.068
Apr	27.50	2.00	83.1	7.50	10.64	3.67	0.62	0.215	2.44	0.068
Mei	27.40	2.00	80.0	8.60	10.64	3.65	0.73	0.214	2.44	0.068
Jun	27.10	2.00	80.5	8.60	10.64	3.59	0.70	0.210	2.44	0.068
Jul	26.90	2.30	73.3	9.10	10.64	3.55	0.95	0.208	2.44	0.068
Aug	27.40	2.90	68.3	12.60	10.64	3.65	1.16	0.214	2.44	0.068
Sept	28.30	2.30	67.0	8.70	10.64	3.85	1.27	0.224	2.43	0.068
Okt	28.60	2.10	70.7	7.10	10.64	3.92	1.15	0.227	2.43	0.068
Nov	28.10	2.10	75.4	5.30	10.64	3.80	0.95	0.221	2.43	0.068
Dec	27.00	1.80	84.7	5.60	10.64	3.57	0.55	0.209	2.44	0.068

ε (rad)	δ (rad)	dr	ωs	n (jam)	N (jam)	f	Ra (MJ/m²/hari)	Rs	Rns	Rnl	Rn	ETo (mm/hari)
0.098	-0.370	1.032	1.53	0.39	11.72	0.130	33.92	9.05	6.97	0.50	6.46	2.32
0.094	-0.231	1.023	1.55	0.37	11.83	0.128	35.97	9.55	7.35	0.47	6.88	2.26
0.095	-0.048	1.010	1.57	0.49	11.97	0.137	37.47	10.13	7.80	0.52	7.28	2.59
0.095	0.165	0.992	1.59	0.60	12.13	0.145	37.56	10.32	7.95	0.55	7.39	2.74
0.101	0.328	0.977	1.60	0.69	12.26	0.151	36.43	10.13	7.80	0.61	7.19	2.82
0.102	0.407	0.968	1.61	0.69	12.32	0.150	35.48	9.86	7.59	0.61	6.98	2.73
0.114	0.375	0.968	1.61	0.73	12.30	0.153	35.74	9.99	7.69	0.70	7.00	3.15
0.119	0.240	0.976	1.59	1.01	12.19	0.174	36.81	10.72	8.26	0.83	7.43	3.82
0.115	0.038	0.991	1.57	0.70	12.03	0.152	37.28	10.40	8.01	0.71	7.30	3.65
0.107	-0.168	1.008	1.55	0.57	11.88	0.143	36.25	9.93	7.64	0.62	7.02	3.31
0.103	-0.334	1.023	1.54	0.42	11.75	0.132	34.30	9.19	7.08	0.55	6.53	2.94
0.097	-0.407	1.032	1.53	0.45	11.69	0.134	33.18	8.93	6.88	0.52	6.36	2.33

Average rainfall

The algebraic method is used to determine the average rainfall. This approach was chosen because it is objective, unlike the isohyet method which is also influenced by subjective factors (Suyono & Takeda, 2003).

Table 3 Results of calculation of average rainfall

Bulan	Periode	1	2	3	4	5	6	7	8	9	10
Januari	I	320.0	301.0	279.7	218.0	196.3	171.7	169.7	107.3	81.7	57.0
II	419.0	344.3	302.0	272.3	261.3	248.0	213.3	197.7	108.0	21.0	
Februari	I	370.7	299.0	287.7	251.7	234.7	219.7	195.7	192.3	154.3	123.0
II	383.0	335.3	333.0	228.7	213.3	202.3	200.0	163.7	160.3	147.0	
Maret	I	411.0	356.0	293.3	276.7	238.0	234.3	228.3	205.0	178.7	170.0
II	344.3	253.0	250.7	243.3	224.0	197.0	194.3	193.0	177.3	98.0	
April	I	357.0	302.7	218.7	183.3	180.0	174.0	158.0	151.7	137.7	98.0
II	244.3	160.3	160.0	142.7	124.0	118.3	115.3	88.0	66.7	45.0	
Mei	I	178.0	145.3	100.3	83.7	81.3	69.3	46.7	34.7	13.3	0.0
II	138.0	120.7	97.7	78.3	77.0	56.0	25.0	9.7	0.0	0.0	
Juni	I	141.0	70.3	69.0	61.7	43.3	38.0	36.0	43.3	4.3	3.0
II	104.3	102.3	64.0	55.0	48.0	34.7	24.0	11.7	0.0	0.0	
Juli	I	140.9	67.7	53.7	45.7	43.7	19.7	15.7	7.7	0.0	0.0

II	87.1	77.3	72.3	47.0	37.0	33.0	3.0	0.0	0.0	0.0	
Agustus	I	32.3	16.1	14.0	10.7	10.0	5.3	0.0	0.0	0.0	0.0
II	45.3	24.7	24.3	6.3	2.7	1.4	0.0	0.0	0.0	0.0	
September	I	76.7	41.7	18.3	14.0	3.0	1.7	1.3	0.0	0.0	0.0
II	154.0	35.3	15.3	12.0	5.7	2.7	1.0	0.0	0.0	0.0	
Oktober	I	185.0	146.3	39.7	31.3	30.7	23.4	2.3	0.0	0.0	0.0
II	199.0	179.3	153.7	101.7	71.5	53.3	26.0	18.3	10.0	0.0	
November	I	277.0	140.0	126.7	119.3	104.3	97.3	94.7	75.6	33.0	10.0
II	248.0	231.7	191.3	173.0	155.3	150.0	135.7	130.7	68.0	42.0	
Desember	I	253.0	235.0	208.0	201.3	200.0	173.3	155.7	137.0	132.3	101.0
II	330.0	273.7	263.0	250.0	172.7	170.7	151.7	133.3	101.0	61.0	

Effective rainfall

Based on the presentation in the table, rice plants need 70% of effective rainfall. The effective rainfall calculation method is 70% of R80, based on the period at that time (Salilama et al., 2018). the average monthly rainfall value and the average monthly harvest are represented by ET (*USDA(SCS),1696).*

Table 4 Results of calculation of effective rainfall of rice

moon	era	R80	Re paddy	
			70% R80	mm/day
January	I	107,3	75,11	5,01
	II	197,7	138,39	9,23
February	I	192,3	134,61	9,62
	II	163,7	114,59	8,19
March	I	205,0	143,50	9,57
	II	193,0	135,10	9,01
April	I	151,7	106,19	7,08
	II	88,0	61,60	4,11
May	I	34,7	24,29	1,62
	II	14,7	10,29	0,69
June	I	43,3	30,31	2,02
	II	23,7	16,59	1,11
July	I	7,7	5,39	0,36
	II	1,0	0,70	0,05
August	I	0,0	0,00	0,00
	II	0,0	0,00	0,00
September	I	0,1	0,07	0,00
	II	0,0	0,00	0,00
October	I	0,3	0,21	0,01
	II	22,0	15,40	1,03
November	I	75,6	52,92	3,53
	II	130,7	91,49	6,10
December	I	137,0	95,90	6,39
	II	133,3	93,31	6,22

Calculation of land preparation water needs

Based on the presentation in table 5 of the results of the calculation of water needs during land preparation with a water saturation value (S) of 300 mm, the water demand during land preparation (IR of land preparation) was obtained at 12.45 mm/day for the month of January (Azni et al., 2025).

Table 5 results of calculation of water needs for land preparation

moon	Eto	Eo	P	M	T	S	K	IR
	mm/day	mm/day	mm/day	mm/day	day	Mm		mm/day
Jan	2,32	2,55	2	4,55	30	300	0,46	12,45
Feb	2,26	2,49	2	4,49	30	300	0,45	12,41
Mar	2,59	2,85	2	4,85	30	300	0,48	12,62
Apr	2,74	3,01	2	5,01	30	300	0,50	12,72
May	2,82	3,10	2	5,10	30	300	0,51	12,77
Jun	2,73	3,00	2	5,00	30	300	0,50	12,71
Jul	3,15	3,47	2	5,47	30	300	0,55	12,98
Ags	3,82	4,20	2	6,20	30	300	0,62	13,42
Sept	3,65	4,02	2	6,02	30	300	0,60	13,31
Oct	3,31	3,64	2	5,64	30	300	0,56	13,08
Nov	2,94	3,23	2	5,23	30	300	0,52	12,84
Des	2,33	2,56	2	4,56	30	300	0,46	12,45

Calculation of irrigation water needs

The middle daily period is intended for the irrigation area of the Bsd 1 secondary channel range as part of meeting irrigation water needs (Wlary et al., 2023).

Throughout the year, the planting frequency for the rice pattern is 2 times with the variety in the usual category.

Table 6 Results of calculation of irrigation water needs

Musim Tanam	Bulan	Periode	Hari	ETo	P	WLR	Re	Padi					
								Koef. Tanaman	Etc	NFR	IR	DR	
				(mm/hr)	(mm/hr)	(mm/hr)	(mm/hr)	kc	(mm/hr)	(mm/hr)	(mm/hr)	(lt/dt/ha)	(m³/dt)
I	NOV	1	15	2,94	2		3,53	LP	12,84	11,31	17,40	2,01	1,25
		2	15	2,94	2		6,1	LP	12,84	8,74	13,45	1,56	0,96
	DES	1	15	2,33	2		6,39	LP	12,45	8,06	12,40	1,44	0,89
		2	16	2,33	2	1,1	6,22	1,1	2,56	0,56	0,86	0,10	0,06
	JAN	1	15	2,32	2	1,1	5,01	1,1	2,55	0,64	0,99	0,11	0,07
		2	16	2,32	2	2,2	9,23	1,1	2,55	2,48	3,82	0,44	0,27
	FEB	1	15	2,26	2	1,1	9,62	1,1	2,49	4,03	6,20	0,72	0,45
		2	15	2,26	2	1,1	8,19	1,1	2,49	2,60	4,00	0,46	0,29
	MAR	1	15	2,59	2		9,57	1,05	2,72	4,86	7,48	0,87	0,54
		2	16	2,59	2		9,01	0,9	2,33	4,68	7,20	0,83	0,52
	APR	1	15	2,74	2		7,08	0	0,00	5,08	7,82	0,91	0,56
II		2	15	2,74	2		4,11	LP	12,72	10,61	16,32	1,89	1,17
	MEI	1	15	2,82	2		1,62	LP	12,77	13,15	20,23	2,34	1,45
		2	16	2,82	2		0,69	LP	12,77	14,08	21,66	2,51	1,55
	JUN	1	15	2,73	2	1,1	2,02	1,1	3,00	4,08	6,28	0,73	0,45
		2	15	2,73	2	1,1	1,11	1,1	3,00	4,99	7,68	0,89	0,55
	JUL	1	15	3,15	2	2,2	0,36	1,1	3,47	7,31	11,24	1,30	0,81
		2	16	3,15	2	1,1	0,05	1,1	3,47	6,52	10,02	1,16	0,72
	AGS	1	16	3,82	2	1,1	0	1,1	4,20	7,30	11,23	1,30	0,81
		2	15	3,82	2		0	1,05	4,01	6,01	9,25	1,07	0,66
	SEP	1	15	3,65	2		0	0,9	3,29	5,29	8,13	0,94	0,58
		2	15	3,65	2		0	0	0,00	2,00	3,08	0,36	0,22
	OKT	1	15	3,31	2		0,01		0,00	1,99	3,06	0,35	0,22
		2	16	3,31	2		1,03		0,00	0,97	1,49	0,17	0,11

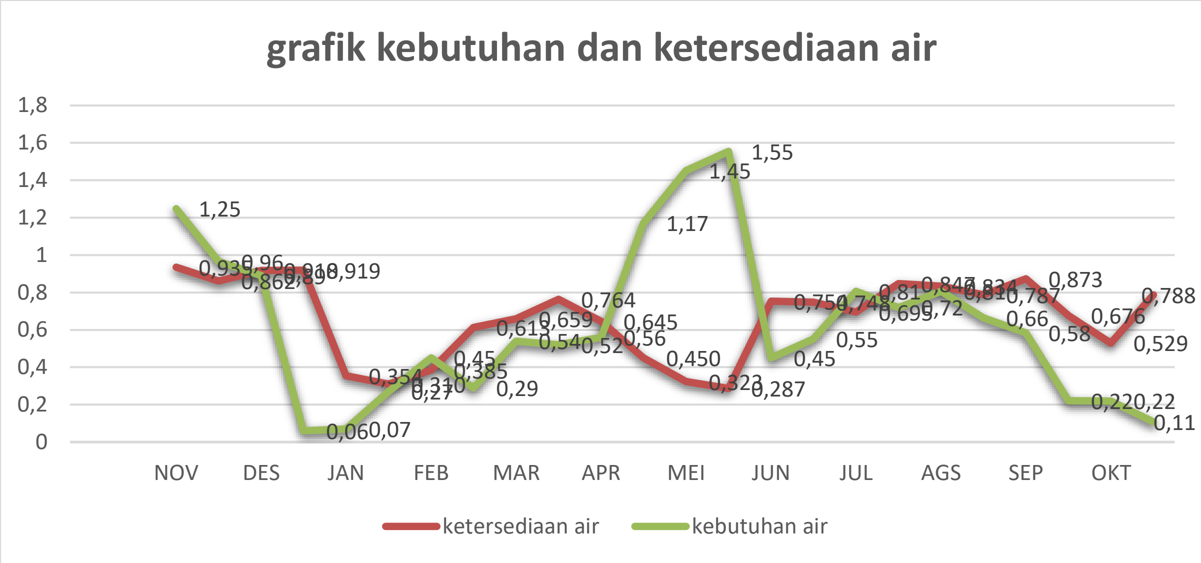

Figure 3. Graph of water demand and availability.

The graph above shows the difference between water demand and availability. In some months, water needs exceed availability, indicating a potential water shortage or drought. On the other hand, in other months, water availability may be higher than needed, indicating a potential water surplus. So it is necessary to have water management and water conservation so that rice water needs can be met optimally.

CONCLUSION

Based on data processing and analysis, conclusions can be drawn, At the beginning of November, the amount of irrigation water needed for paddy pattern crops starting from the beginning of processing with the irrigation area of the bsd 1 secondary channel range of 620 Ha, the maximum and minimum irrigation values were obtained from the results of manual calculations (concept kp – 01), namely 1.55 m3/s and 0.06 m3/s. The maximum need occurs in the period of 2 months of May and the minimum needs occur in December of the period of 2 months of December. The high rainfall affects the price of irrigation water (IR) needs. The higher the rainfall, the less irrigation water is needed, and vice versa. The need for irrigation water decreases during the rainy season because most of it has been fulfilled by rainfall, while during the dry season, the need for water increases and becomes a challenge in water management.

REFERENCES

Akhirul, A., Witra, Y., Umar, I., & Erianjoni, E. (2020). Dampak Negatif Pertumbuhan Penduduk Terhadap Lingkungan Dan Upaya Mengatasinya. *Jurnal Kependudukan Dan Pembangunan Lingkungan*, *1*(3), 76–84.

Andita, W., & Lipu, S. (2020). Analisis Ketersediaan Air Das Sausu Untuk Kebutuhan Air Pada Di Sausu Bawah, Kabupaten Parigi Moutong. *Rekonstruksi Tadulako: Civil Engineering Journal On Research And Development*, 63–74.

Ardiansa, A., Saleh, M., & Awaluddin, M. (2021). Pengaruh Pertumbuhan Ekonomi Dan Pertumbuhan Penduduk Serta Inflasi Terhadap Pengangguran Dan Kemiskinan Di Kalimantan Timur. *Nusantara: Jurnal Ilmu Pengetahuan Sosial*, *8*(8), 2576–2596.

Aronggear, T. E., Supit, C. J., & Mamoto, J. D. (2019). Analisis Kualitas Dan Kuantitas Penggunaan Air Bersih Pt. Air Manado Kecamatan Wenang. *Jurnal Sipil Statik*, *7*(12).

Azni, I. N., Hasibuan, H. S., & Kusnoputranto, H. (2025). Analisis Kualitas Dan Kuantitas Air Bersih Di Pulau Kelapa, Kepulauan Seribu. *Jurnal Kesehatan Lingkungan Indonesia*, *24*(1), 28–36.

Bumbungan, A. L. D., Doloksaribu, A., & Pamuttu, D. L. (2023). Analisis Kebutuhan Air Irigasi Pada Daerah Irigasi Kampung Sidomulyo. *Musamus Journal Of Civil Engineering*, *6*(01), 15–22.

Latifah, F. (2022). *Analisis Kebutuhan Sarana Dan Prasarana Irigasi Pada Das Way Tembulih Di Kecamatan Ngaras Kabupaten Pesisir Barat*.

Nurmansyah, A., Alkaf, M., Aulia, N., & Nurdiyanto, N. (2024). Analysis Of Micro Hydro Potential As A New Renewable Energy Source:(Case Study: Bangkong Waterfall, Kuningan Regency, Indonesia). *Jurnal Locus Penelitian Dan Pengabdian*, *3*(7), 546–557.

Priyonugroho, A. (2014). *Analisis Kebutuhan Air Irigasi (Studi Kasus Pada Daerah Irigasi Sungai Air Keban Daerah Kabupaten Empat Lawang)*. Sriwijaya University.

Salilama, A., Ahmad, D., & Madjowa, N. F. (2018). Analisis Kebutuhan Air Bersih (Pdam) Di Wilayah Kota Gorontalo. *Radial: Jurnal Peradaban Sains, Rekayasa Dan Teknologi*, *6*(2), 102–114.

Sudjarwadi. (1979). *Pengantar Teknik Irigasi, Fakultas Teknik Ugm, Yogyakarta.*

Sumpala, A. G. T. (2022). *Analisis Kualitas Dan Kuantitas Kebutuhan Air Bersih Dan Alternatif Penyediaan Pada Kawasan Wisata Pantai Bira= Analysis Of Quantity And Quality Of Clean Water Requirements And Alternative Supply In Bira Beach Tourism Area*. Universitas Hasanuddin.

Suyono, S., & Takeda, K. (2003). Hidrologi Untuk Pengairan. *Pradnya Paramita, Jakarta*.

Wiyono, A. (2000). Catatan Kuliah Pengembangan Sumber Daya Air. *Departemen Teknik Sipil Itb, Bandung*.

Wlary, A. P., Salakory, M., & Manakane, S. E. (2023). Analisis Kualitas Dan Kuantitas Air Bersih Di Negeri Paperu Kecamatan Saparua Kabupaten Maluku Tengah. *Ulil Albab: Jurnal Ilmiah Multidisiplin*, *2*(6), 2196–2207.