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Analysis of Water Calculations Kayulemah Reservoir for Irrigation Needs in Kayulemah Village Sumberrejo Sub District Bojonegoro District

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ABSTRACT: Efforts are needed to harvest water in the rainy season to be used in the dry season so as to extend the planting period. The purpose of this study was to find out how much the Kayulemah Reservoir is useful for irrigation needs on 159ha rainfed agricultural land in Kayulemah Village, Sumberrejo District, Bojonegoro Regency. This research was conducted by hydrological analysis, with rainfall data from the Water Resources Public Works Agency of Bojonegoro Regency. Based on the results of the analysis, it can be concluded that the water availability of the Kayulemah Reserver is 199,023 3 and it is estimated that the potential for water availability based on the rainwater that enters the largest reservoir is in February II of 129,729 3. From the calculation of water demand by using soil type (0.12) the standardization of the East Java Public Work Deperatement is more efficient, with water requirements for one planting period for one hectare of 4.269 3/ha and for one-time water needs of planting for 159 ha of 678,771 3. The results of the analysis show that Reserver Kayulemah is only able to irrigate an area of 47 ha out of 159 ha of rainfed rice fields and cannot irrigate the entirety of agricultural land.

KEYWORDS: Calculatios,Reserver,Irrigation, agricultural.

I. INTRODUCTION

Availability of water is an important part for plant growth, and is one of the most important factors for increasing food production, especially in the agricultural sector. Water is one of the most impotant elements in food production, if water is not available or cannot reach the irrigation destination, food production will stop. This means that water resources are a key factor for the sustainability of agriculture, especially irrigated agriculture. In order for these needs to be met, the amount of water released must be in accordance with the water available. (Jayadi, 2000). One of the factors contributing to inhibiting the potential of dry land is the lack of availability of water resources during the dry season. Efforts to overcome the water shortage factor are one of them by carrying out water conservation efforts by storing excess surface water runoff when it rains using small farm reservoirs. The reservoir is used as a reservoir for surface runoff when it rains and can be used for agricultural business during the dry season. Making ponds is generally to irrigate agricultural land, especially in the dry season, other benefits of ponds are in the fisheries and domestic sectors. (Tarigan, 2008). As in the management of other crops on dry land, rice plants on rainfed land require irrigation to increase their productivity. Meanwhile the need for water for plants is highly dependent on rainfall whose existence is very dynamic depending on climatic conditions. Changes in land conditions due to damage to the hydrological function of the watershed

rivers where most of the dry land is located, resulting in the loss of potential water resources for irrigation. Therefore efforts are needed to harvest water in the rainy season to be utilized in the dry season so as to extend the planting period. Bojonegoro Regency is a district that has a lot of potential in the agricultural sector, especially rice. Kayulem Village is a village that is included in the Sumberrejo District which is in the east of Bojonegoro Regency and directly borders with Kepohbaru District. In cultivating their land, the farmers in Kayulemah Village are very dependent on water during the rainy season, apart from that they must be supported by a regular irrigation system. This can be overcome by the availability of water in the Kayu Weak Reservoir with an area of 61,050 m2.

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With the existence of the reservoir, it is hoped that it can be used for irrigation needs, as well as a potential area of ± 159 Ha of rainfed agricultural land can have sufficient water supply and increase cropping intensity, where it is necessary to conduct research to find out how much benefit is provided by the Kayu Weak Pond to water needs irrigation on agriculture in the village of Kayulemah.

With the background described above, the formulation of the problem for this research is:
1. How big is the availability of water in the Kayulemah Reservoir?
2. How much irrigation water is needed for agricultural land?
3. What is the area of land that can be flowed by the Kayulemah Reservoir?

II. RELATED WORK

Previous research

Budi Iswoyo and Annisa Kesy Garside (2021), conducted research with the title "Analysis of the Capacity of the Paniwen Reservoir for Irrigation Water Supplement". This research was conducted using the hydrological analysis research method, the Penman method, the hydrograph method. The results of the technical analysis show that the volume of the reservoir with a probability of 80% is that the Peniwen Embung with an effective reservoir of 52.032.55 m3 can meet the needs of irrigation water for a 75 hectare paddy field with a rice-rice-plants cropping pattern with the beginning of the planting season in January. The results of the analysis of the design flood discharge using the calculation of the Nakayasu Synthetic Unit Hydrograph method with the design flood discharge used in planning this pond is the design flood discharge with a return period of 100 years, namely 46.93m3/second. The reservoir type is a homogeneous backfill type with a length of 123.33 m with a width of 6 m at the top of the pond. From the analysis results, the physical data of the reservoir is obtained: the height of the reservoir is 12 m, the topdam elevation is +407.00 m, the crest spillway elevation is +404.50 m, the total storage volume is 58.167.24 m3, the dead storage volume is 6,134.69 m3.

Theoretical basis

According to Rustam (2010), a reservoir is an artificial building whose function is to accommodate and store water with a certain small volume capacity, smaller than the capacity of a reservoir or dam.while the term irrigation according to Government Regulation number: 7 of 2001 is a human effort in providing and regulating water to support agriculture which types include surface irrigation, underground irrigation, pump irrigation and pond irrigation.The water needs of rice varieties that are generally grown in Indonesia are as follows :

Table 1. Rice Plant Water Needs by Growth Stage

Growth Stage	Local Varitiy			Superior Variety		
	mm/day	l/sec/ha	Period (day)	mm/day	l/sec/ha	Period (day)
Processing land	12,7	1,5	-	12,7	1,5	-
Nursery	3,0	0,4	20	3,0	0,4	20
Primordial Cultivation s/d	7,5	0,9	40	6,4	0,75	35
Primordial Flowers s/d	8,8	1,0	25	7,7	0,9	20
Flower10%s/d Full	8,8	1,0	20	9,0	1,0	20
Flower Fulls/d Ripening	8,4	1,0	20	7,8	0,9	20
Ripening s/d Harvest	0	0	15	0	0	15

Source: P3A/GP3A/IP3A Empowerment Module, 2021

The water requirement for secondary crops (soybeans, corn, peanuts, green beans, etc.) and horticulture (vegetables, fruits, ornamental plants and medicines) is smaller than for rice.

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Table 2.Water Needs for Several Palawija and Horticultural Plants

Plant Species	Water Requirement According to Growth Perio(l/sec/ha)				
	Beginning	Development	Growth	Ripening	Harvest
Jagung	0,25	0,36	0,50	0,37	0
Kedelai	0,25	0,35	0,50	0,30	0
KacangHijau	0,17	0,30	0,40	0,30	0
KacangTanah	0,17	0,34	0,40	0,35	0
Cabai	0,17	0,34	0,40	0,35	0
BawangMerah	0,17	0,34	0,40	0,35	0
Melon	0,17	0,34	0,40	0,35	0

Source: P3A/GP3A/IP3A Empowerment Module, 2021

Hydrology is a field of science that studies the occurrence and distribution or natural distribution of water on earth. Rainfall data for an area is the main data to determine the average rainfall and min catch. The rain that is expected to occur during one growing season is called the effective rainfall. The effective rain period for a paddy field starts from tillage until the plants are harvested, not only during the growth period (Subramanya, 2005).The amount of effective rainfall is determined at 70% of the monthly average rainfall with a 20% probability of failure (Rainfall *R80*). For rice plants, the effective rainfall value can be calculated using the following equation:

$Re=(0,7xR_{80})/n$ .....(1)

As for palawija crops, the effective rainfall value is calculated by the following equation:

$Re=(0,5xR_{80})/n$ .....(2)

With : Re = Effective rainfall (mm)

Volume or also called capacity is a calculation of how much space can be occupied in one object. The calculation of the volume of the reservoir is carried out to find out how much water is available in the catchment area to irrigate the rice fields or irrigation needs. In carrying out calculations to find out the volume of water availability in the reservoir, use the formula calculation:

$$V=PxLxT \quad \text{.....(3)}$$

In order to know the average depth of the reservoir can be done. with all of the calculated results divided by the number of points calculated as follows.

$$H=\frac{h1+h2+h3+h4+h5.....h10}{10} \quad \text{.....(4)}$$

With :

H = Average depth height

$h1$ = Point depth 1

In Indonesia, the water demand is usually in the range of 1.0-1.5 liters/second/hectare. There are several assumptions that must be considered, namely:

a. Water infiltration and evaporation in pond ponds are considered very small.

b. There is no supply of water entering the reservoir during the dry season

III. METHODOLOGY

Data Collection Stages

The stages of data collection in this research are to obtain primary data and secondary data. Primary data is obtained by measuring the depth by inserting a thread with a pole so that it reaches the middle of the reservoir, the end of the thread is loaded and then inserted into the reservoir by taking 10 points. Secondary data was obtained by studying literature and collecting data indirectly. The secondary data needed is daily rainfall data for the last 10 years in 2012–2021 at 3 rainfall stations, namely the Mekuris rainfall station, the Cawak rainfall station and the Kerjo rainfall station.

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Hydrological Analysis

In this research, data analysis was carried out based on hydrological analysis to determine average rainfall and effective rainfall with rainfall data for the last 10 years from the Bojonegoro Regency Water Resources Public Works Departement How big is the availability of water in the Kayulemah reservoir to irrigate the rice fields in Kayulemah village, it is necessary to calculate the availability of water by calculating the volume or capacity of the reservoir.

Water Availability Analysis

To analyze the existing water demand as a support for increasing rice and secondary crops yields, the Relative Palawija Factor (RPF) and Relative Palawija Area (RPA) calculation methods have been used in the East Java region

IV. EXPERIMENTAL RESULTS

Average Rainfall

Based on the influence map of the Thiessen Polygon rainfall station, there are three rain stations that have the potential to enter the reservoir, namely Mekuris Station, Cawak Station and Kerjo Station. Based on data from the Bojonegoro Regency Water Resources Public Works Service, it is known that the average rainfall at the three rainfall stations namely, at the Mekuris rainfall station is 182.99 mm, the Cawak rainfall station is 202.79 mm and the Mekuris rainfall station is 202.79 mm. Kerjo of 186.23 mm to calculate the average rainfall in a measurement area carried out at several stations at the same time is added up and then divided by the number of stations, by using the existing formula, the average total rainfall at the three rainfall stations is 190.67 mm.

Mainstay Rainfall

Daily rainfall data with a 10 year period from three stations, namely the Mekuris rainfall station, the Cawak rainfall station and the Kerjo rainfall station were compiled and averaged. The average price of daily rainfall is sorted from the smallest to the largest value based on the name of the month, then the probability value is 80% fulfilled. Here's how to calculate the probability value. For the next opportunity value in the same way as the opportunity value above, with the Basic Year Method it can be calculated *R*80 with a calculated failure ratio of 20%. The probability value of rainfall used is with a reliability level of 80%. After analyzing the calculation, it is obtained that the rainfall value with a reliability of 80% is 27.27 mm.

Effective Rainfall

Effective rainfall is measured from March to December

Reservoir Water Volume

To determine the volume of water in the reservoir, to determine the volume of the reservoir can be known by the following formula:It is known that the length of the reservoir is 1110 m, the width of the reservoir is 55 m and the depth of the reservoir is 3.26 m,after doing the calculations, it can be seen that the volume of water availability at the Kayulemah Reservoir is 199,023 *m*3

Potential of Rain Water Entering the Reservoir

The Kayulemah Reservoir only relies on rainwater. Recapitulation of estimated volume of water availability based on rainwater from January to December can be seen in the table3

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Table 3. Potential of Rain Water Entering the Reservoir

No	Month	Period	Effective Rain Discharge (m^3/sec)	Availability of Water Volume (m^3)
1	January	I	0,0252	32.659,00
		II	0,0798	103.420,80
2	February	I	0,0245	31.752,00
		II	0,1001	129.729,60
3	March	I	0,0273	35.380,80
		II	0,0462	59.875,20
4	April	I	0,0693	89.812,80
		II	0,0588	76.204,80
5	May	I	0,0294	38.102,40
		II	0,0035	4.536,00
6	June	I	0,0056	7.257,60
		II	0	0,00
7	July	I	0	0,00
		II	0	0,00
8	August	I	0	0,00
		II	0	0,00
9	September	I	0	0,00
		II	0	0,00
10	October	I	0	0,00
		II	0,0042	5443,20
11	November	I	0,0294	38102,40
		II	0,0413	53524,80
12	December	I	0,091	117936,00
		II	0,0469	60782,40

Calculating water needs

Regional Regulation No. 15 of 1986 Article 24 paragraph 1. The water requirement for rice plants or the crop coefficient is based on the provision of water for 24 consecutive hours (continuously). Paddy fields covering an area of 159 Ha consist of 4 Blocks (A, B, C and D). In terms of water requirements for each type of plant, it is different, so based on research in East Java, in general, the calculation of providing water to plants is classified into several types of plants with different coefficient pricesdifferent. The calculation results are as follows:

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Table 4. Water Demand Simulation (RPF/RPA)

No	Month	$KebutuhanAirIrigasim^3/det$	
		RPF0,20	RPF0,12
1	November	0,215	0,129
2	December	0,127	0,076
3	January	0,127	0,076
4	February	0,127	0,076
5	March	0,213	0,128
6	April	0,126	0,075
7	May	0,126	0,075
8	June	0,126	0,075
9	July	0,016	0,01
10	August	0,016	0,01
11	September	0,016	0,01
12	October	0,016	0,01

Water Needs One Time Planting Period

The calculation of the water needs of rice plants for one planting period can be calculated using the following calculations:

Seeding : 7 days
Processing : 7 days
Growth : 90 days

rom the results of the calculation above, it can be seen that the water requirement per hectare for one planting season uses an RPF of 0.20 based on the type of soil at the research location of 7,116 m3/ha.

Based on the calculation results, it can be seen that the water requirement per hectare for one planting season uses an FPR of 0.12 set by the East Java Public Works Department at 4,269 m3/ha.

From the calculation of the FPR based on the geological map and the standards set by the East Java Public Works Department, it can be obtained that the water demand value with an FPR of 0.12 (alluvial) is 7,116 m3/ha and for an FPR of 0.12, the DPU standard for East Java is 4,269 m3/ha

Based on the provision of water for 24 consecutive hours (continuously), from the calculation of water needs using soil type determinations based on the stipulations of the East Java Public Works Department, it is more efficient, to find out the water requirement for one planting season in a 159 ha rainfed rice field as following :

= Standard paddy field area × water requirement per hectare
= 159 × 4.269
= 678,771 m3

It can be seen that the water requirement for one planting period in the rain-fed rice fields of the village of Kayulemah with an area of 159 ha is 678,771 m3

or the water needs of each block can be calculated using the following calculation:

Block A = 8 × 4.269 = 34.152 m3
Block B =24 × 4,269 =102.456 m3
Block C =47 × 4,269 =200,643 m3
Block D =80 × 4,269 =341,520 m3

The availability of water in the Kayupuh Reservoir is 199,023 m3, so the available water can irrigate an agricultural area of:

$$=\frac{199.023}{4.269}$$
= 47 ha

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So the water available in the Kayulemah Reservoir is only able to supply 47 ha of agricultural land out of 159 ha and has not been able to irrigate all of the agricultural land in Kayulemah village. If the water is not sufficient (less) then the provision of water must be rotated 10 days (240 hours).

V. CONCLUSION

Based on the analysis and discussion that has been done, the following conclusions can be drawn:

1. Based on the calculation of the volume of water in the Kayulemah Reservoir, it was found to be199.023 m3. It is estimated that the potential for water availability based on rainwater that enters the largest Embung is in February II of 129.729 m3.
2. Based on the provision of water for 24 consecutive hours (continuously), from the calculation of water requirements using soil type (0.12) the standardization provisions of the East Java Ministry of Public Works are more efficient, with water needed once a planting season for one hectare of 4.269 m3/ha and for an area of 159 ha of 678,771 m3.
3. From the results of the analysis, the Kayumerah Reservoir is only able to irrigate 47 ha of 159 ha of rainfed rice fields and has not been able to irrigate the entire agricultural land in the village of Kayulemah.

REFERENCES

[1] Al Hadi, Analysis of Reservoir Capacity and Reliability of Embung Wukisari I,Final Assignment Department of Civil Engineering, Faculty of Civil Engineering and Planning, UniversityIndonesian Muslims, YogyakartaA, 2021
[2] Fidryah, Optimizing the Management of Gempol Reservoir Water Resources, Final ProjectCivil Engineering Study Program, Faculty of Engineering, Bhayangkara University, Surabaya, 2019
[3] Hadimuljono, Guidelines for the Development of Small Reservoirs and Buildings, Other Water Reservoirs, Minister of Public Works and People's Housing of the RepublicIndonesia, 2018
[4] Harjono, Planning of Reservoir Dimensions in Sengon Village, Kec. Ngamboo ForThe Need for Irrigation Land, Vol. 3 No. 2: De'Teksi Unigoro Civil Engineering Journal,Bojonegoro, 2018
[5] Jayadi, Rachmat, Water Resources Development, Department of Civil Engineering, Gadjah Mada University, Yogyakarta, 2000
[6] Lukis et al, Optimization of Uwai Pangonan Regency Irrigation Area Park PatternsKampar, Come FTEKNIK Volume 1 No 2, Pekanbaru, 2014
[7] Rustam, R.K, Water Spatial. Yogyakarta: CV. Andi, 2010
[8] Sarasidyah,Utilization of the Ngangkrik Reservoir for Water SupplementIrrigation in Ngangkrik Hamlet, Triharjo Village, Sleman, Final Assignment of Civil Engineering DepartmentFaculty of Civil Engineering and Planning, Indonesian Islamic University, Yogyakarta, 2020
[9] Soedibyo, Dam Engineering, PT Pradnya Paramita, Jakarta, 1993
[10] Soewarno, Hydrology for Data Analysis Volume 1, Citra Aditya Bakti: Bandung, 1995
[11] Suprapto, Development of an Irrigation Operations Management System, Center for Research and DevelopmentWater Resources, Bandung, 2014
[12] Sutopo, Utomo, Irrigation and Waterworks, Semarang State University LPPM,Semarang, 2019
[13] Tarigan, Suria Darma, Effectiveness of ponds for irrigation of horticultural crops in cikakak sukabumi, Agriculture Faculty, Bogor Agricultural University, 2008
[14] Triatmodjo, Applied Hydrology, Beta Offset. Yogyakarta, 2013

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