International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province

Freddy Barus[1], Pitojo Tri Juwono[2], Runi Asmaranto[3]
[1, 2, 3]Water Resources Management Master Program, Brawijaya University, Malang, Indonesia

Abstract— *In Paku Beto irrigation area is one of the irrigation areas that has considerable potential to be developed in the agricultural sector. The availability of water is one of the important factors in supporting the success of agriculture, in addition to the facilities and infrastructure it has. During the rainy season the discharge can be allocated tofulfill the needs of plants, while in the dry season the water needs are not fully covered. In Paku Beto Village, there is already a reservoir that is used to fulfill the needs of plants, but the current volume of the reservoir is not optimal to fulfill the needs of irrigation water in the hope that this irrigation area will fulfill its water needs as a whole. The amount of water required for the irrigation system at the area is generally influenced by factors such as the method of giving water, the way of managing and maintaining the existing canals and buildings, the amount of rain that falls, the time of planting and tillage, and the cropping pattern used. The purpose of this study was to evaluate the performance of the Paku Beto reservoir in fulfilling irrigation water needs in the Paku Beto Irrigation Area. One of the efforts made is to analyze the balance between demand and the availability of existing discharge. Paku Beto Reservoir's fill discharge used to fulfill irrigation water demand for agricultural land in each period is 24,127 m^3 in October, 29,120 m^3 in November, 38,422 m^3 in December, 48,704 m^3 in January, 42,435 m^3 in February, 43,821 m^3 in March, 44,422 m^3 in April, 37,435 m^3 in May, 29,717 m^3 in June, 21,987 m^3 in July, 24,123 m^3 in August, 25,666 in September each period.*

Keywords— *Paku Beto Reservoir, Evaluate the performance, Irrigation, Discharge, Water balanced.*

I. INTRODUCTION

Paku Beto irrigation area is one of the irrigation areas that has considerable potential to be developed in the agricultural sector. The availability of water is one of the important factors in supporting the success of agriculture, in addition to the facilities and infrastructure it has. During the rainy season the discharge can be allocated tofulfill the needs of plants, while in the dry season the water needs are not fully coveredBased on the data, East Barito Regency is one of the regencies in Central Kalimantan Province, which has an area of 3,834 km2, with a geographical location between 01°04'00"- 02°02'00" latitude and 114°55'00"- 115°20'00" East Longitude, with an area of 6,637 ha of rice fields and 59,470.12 ha of plantations [1]. In Paku Beto Village, the land is dry and flat, with some of the vegetation in shrubs, forests, and oil palm and rubber plantations. Paku Beto Village is one of the villages experiencing water shortages to fulfill the irrigation water needs of agricultural land areas. Generally occurs in the dry season, while in the rainy season, the water is very abundant. One alternative solution to the problem in fulfilling the shortage of irrigation water needs is evaluate the performance of the Paku Beto reservoir in filling irrigation water needs in the Paku Beto Irrigation Area. One of the efforts made is to analyze the balance between demand and the availability of existing discharge [2].

In the area of agricultural land, there is already a reservoir located in the Mira Pakat farmer group, which functions to fulfill the irrigation water needs of the farmer group. In general, the physical condition of the Paku Beto Reservoir is still excellent and well-maintained, but the current volume of the reservoir is not optimal to fulfill the needs of irrigation water in the hope that this irrigation area will fulfill its water needs as a whole. The amount of water required for the irrigation system at the site is generally influenced by factors such as the method of giving water, the way of managing and maintaining the existing canals and buildings, the amount of rain that falls, the time of planting and tillage, and the cropping pattern used [3] (Nuf'a, et al., 2016). Therefore, it is necessary to have a way for the Paku Beto Reservoir so that the output of water for irrigation can be balanced and regulated optimally. The purpose of this study is to determine the amount of discharge filling the reservoir to fulfill irrigation water needs, the amount of release required for irrigation needs.

The location of this research study is in Paku Beto Village, Paku District, East Barito Regency. Access to the location can be reached by land. With the distance from Palangka Raya City to Tamiang Layang City ± 255 km, and Tamiang Layang City to the reservoir location ± 40 km. To find out the balance between water demand and availability, the water balance equation will be used.

II. REVIEW OF LITERATURE

In implementing a reservoir, it is necessary to have fields of knowledge that support each other for the perfection of the planning results. The areas of science include geology, hydrology, hydraulics, and soil mechanics [4]. Each watershed has different unique characteristics. This requires great care in applying a suitable theory to the drainage area. In this literature review, a brief description of water requirements, hydrological analysis, theoretical basics of the implementation of the reservoir will also be described, which will be used in the calculation of construction and complementary buildings [5]. Management of reservoirs in water-scarce environments with significant hydrological uncertainty and suboptimal management can cause economic losses to water users during droughts or water spills during floods [6] (Davidsen et al., 2014). An essential characteristic of a reservoir is its ability to hold water [7]. Therefore it is essential to understand the features of the reservoir. The policy for the operation of reservoir storage capacity involves the division into several sections based on the planned function in the process of the reservoir/small dam, the distribution of storage capacity can be permanent or variable depending on the season or other factors [8]. The physical condition of the Paku Beto Reservoir is currently still in good condition, and it can be seen on the sides of the wall or body of the reservoir, which is made of concrete and is still in good condition. Paku Beto Reservoir has a length of 57 m, a width of 40 m, and a depth 6 m. This reservoir consists of an adequate reservoir and a dead reservoir.

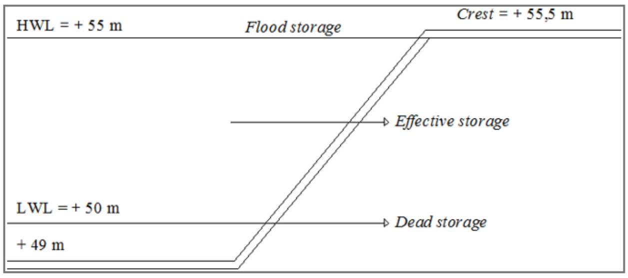

Fig. 1. Paku Beto Reservoir Zone Source: Observations.

The reservoir dead storage is at an elevation of 49 m, and the maximum adequate water level is at the height of 55 m. The reservoir capacity is 13,680 m^3. In operation, rainwater is stored in the reservoir building and operated to fulfill water needs during the dry season. During the dry season and the water stored in the reservoir is below the adequate storage, to fulfill the water needs of plants, a pump can be used to pump water from the reservoir to agricultural land. The location of the reservoir is also equipped with a pump house. The operation of a reservoir is the process of collecting the water flow into a reservoir and releasing water that has been holded for various specific purposes [9] Completion or policy-making of reservoir operations cannot be separated from optimization to determine maximum profits and or minimum losses for optimal utilization of reservoir water [10]. The guideline for the operation of the reservoir is how to use the reservoir storage capacity in determining the regulation of flow for specific purposes where the purpose of this reservoir is irrigation water. In the operation and optimization of reservoirs, an optimal operating policy is needed to determine the actual optimal value of the decision and state variables [11](G. Naadimuthu and E. S. Lee, 1982).

One form of reservoir equation that is often used for reservoir/reservoir operations is the reservoir/small dam balance equation which gives the relationship between inflow (rain), outflow, and changes in the reservoir which is called behavioral analysis (simulation model) in this case is a stage transformation for linier programs. The equation is stated as follows.

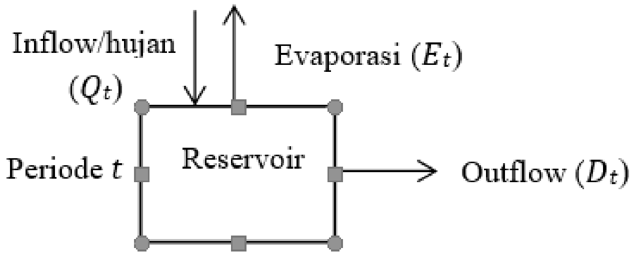

Fig. 2. Reservoir Model.

For the simulation model of reservoirs (small dam), the simulation period can cover one year of operation or more depending on the needs. One year of operation is further divided into several periods: monthly, 15 days, ten days, weekly, or daily. The general equation for simulating reservoir operations is the reservoir balance equation. In this case, it can be seen in the previously described equation. One form of reservoir equation is often used is the reservoir/small dam balance equation which gives the relationship between the inflow (rain), outflow, and changes in the reservoir which is called behavioral analysis (simulation model)

III. RESEARCH METHODOLOGY

In analyzing the balance between water demand and availability to determine the performance of the Paku Beto Reservoir. First, a survey and investigation must be carried out from the area or location in question to obtain data related to optimization and flow patterns that are completed and observed.

A. *Data Collection*

Every time researching optimization will need supporting data, both primary data and secondary data.

(1) Primary data is obtained from direct interviews with interested parties and other actual data related to current conditions in the field.
(2) Secondary data, namely archival data obtained from relevant agencies and data that affect this research. Every time researching optimization will need supporting data, both primary data and secondary data.

In research on the Performance evaluation of the Paku Beto reservoir, in Paku Beto Village, Paku District, East Barito Regency, the data collected are.

1. Topographical data

   This data is used to determine the elevation, the layout of the reservoir's location, and estimate the reservoir's volume.

2. Irrigated crop data

   This data is used to determine the amount of water reservoir required by the reservoir to fulfill the need for irrigation water and plan an efficient cropping pattern.

3. Hydrological data

This data is in the form of climatological data, evapotranspiration and other supporting data for the last ten years to determine the nature and characteristics of the hydrology above the ground surface, wherein this thesis the most influential hydrological factor is rainfall (precipitation).

4. Soil data

This soil data is needed to determine the condition of the soil at the location of the reservoir. This data is in the form of physical data and soil mechanics (Das, 1995). This aims to determine the chance of water loss due to infiltration in the reservoir.

B. *Implementation Methodology*

The implementation method is used to determine the steps to be taken in evaluating the performance of the Paku Beto reservoir in Paku Beto Village, Paku District, East Barito Regency. The methodology used is.

1. Problem Identification

   To be able to solve the problem correctly, the main concern must be known first. The solution to the problem that will be made must refer to the issues that occur.

2. Literature Study

   This literature study was conducted to obtain a reference in the analysis of calculation data to reservoir performance evaluation.

3. Data Collection

   The data is used to reservoir performance evaluation. In addition, data collection was carried out by direct interviews with resource persons from relevant agencies (PSDA) for problem-solving.

4. Data Analysis

   The data that has been obtained is processed and analyzed according to their needs. Each information is different in processing and analysis. With appropriate processing and analysis, variables will be accepted that will be used in Evaluating the performance of the Paku Beto reservoir

5. Optimization Planning

   The results of the data analysis are used for reservoir performance evaluation plans and adjusted to the field conditions that support the reservoir performance evaluation.

C. *Thesis Flowchart*

Performance evaluation of the Paku Beto reservoir is closely related to a clear flowchart, appropriate analytical methods, and completeness of supporting data. The stages of Performance evaluation of the Paku Beto reservoir are as follows.

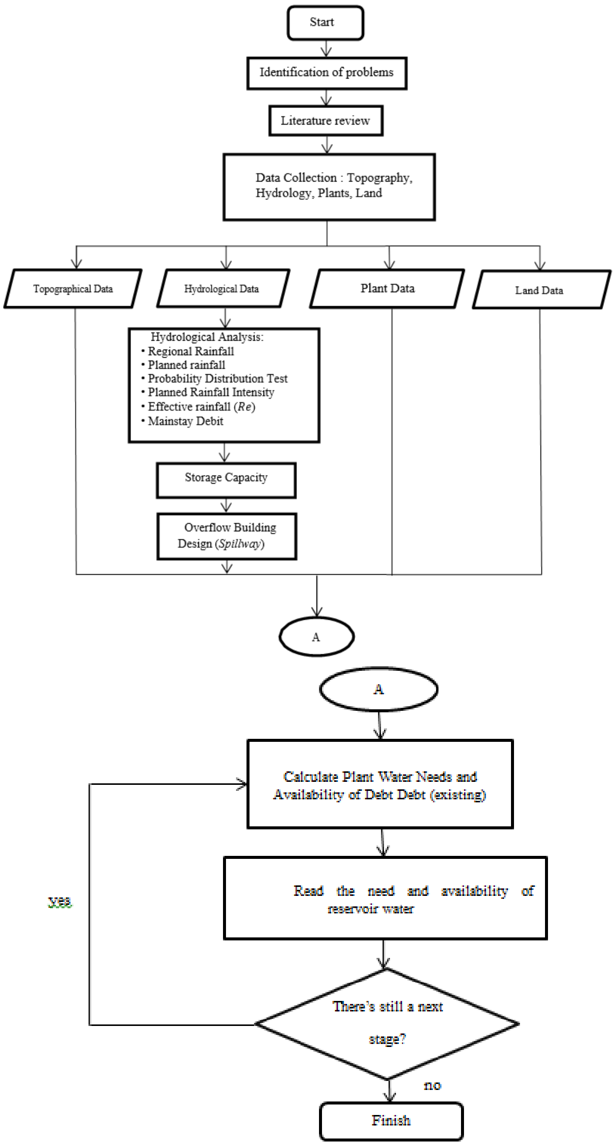

Fig. 3. Reservoir Performance Evaluation Flowchart.

IV. RESULT

A. *Topographic Data*

This reservoir is used to fulfill the irrigation water needs of Pakat Maeh Farmer Group in Paku Beto Village.

TABLE I. Coordinates of Land and Water Sources for Farmer Groups in Paku Beto Village.

No	Farmer Group Name	X	Y	Elev. (m)
(1)	(2)	(3)	(4)	(5)
1	Pakat Maeh Farmers Group's Land Coordinates	- 1°56’30’’	115°14’13’’	48,0
2	Paku Beto Reservoir Coordinates	- 1°56’29’’	115°14’15’’	49,0
3	Tampa Climatology Post Coordinates	- 1°55’26’’	115°7’7’’	57,7

B. *Hydrological Data Analysis*

The data for determining the planned flood discharge to plan spillway in this study is rainfall data, where rainfall is one

Freddy Barus, Pitojo Tri Juwono, and Runi Asmaranto, “Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province,” *International Research Journal of Advanced Engineering and Science*, Volume 6, Issue 3, pp. 388-395, 2021.

ISSN (Online): 2455-9024

of several data that can be used to estimate the planned flood discharge. The maximum daily rainfall data from Tampa Station can be seen below.

TABLE II. Maximum Rainfall Data.

No	Years	Daily Planned Rainfall (mm)
		Tampa
(1)	(2)	(3)
1	2020	102,7
2	2019	148
3	2018	101,4
4	2017	78,7
5	2016	123,6
6	2015	122
7	2014	62,6
8	2013	53,5
9	2012	180,7
10	2011	126
Amount of Rain		1.099,2
Average		109,92

The process of calculating the consistency test uses the Rescaled Adjusted Partial Sums (RAPS) method. It can be seen in Table III below.

TABLE III. Tampa Station Rainfall Data Consistency Test with the RAPS Method.

No	Years	X	Xi - Xaverage	Sk*	(Xi - Xaverage)²/n	Sk**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	2020	102,7	-7,22	-7,22	5,21	-0,20
2	2019	148	38,08	30,86	145,01	0,84
3	2018	101,4	-8,52	22,34	7,26	0,61
4	2017	78,7	-31,22	-8,88	97,47	-0,24
5	2016	123,6	13,68	4,80	18,71	0,13
6	2015	122	12,08	16,88	14,59	0,46
7	2014	62,6	-47,32	-30,44	223,92	-0,83
8	2013	53,5	-56,42	-86,86	318,32	-2,36
9	2012	180,7	70,78	-16,08	500,98	-0,44
10	2011	126	16,08	0,00	25,86	-7,71E-16

C. Effective Rainfall

The realibility rainfall with a probability of 80% is determined in order using the following formula, where n is the number of years of observation of rainfall data, which is 10 years. The amount of effective rainfall for paddy crops is determined by 70% of the 80% reliability rainfall each observation period, while the amount of effective rainfall for secondary crops is 50% of the 80% reliable rainfall each observation period. In the reliability discharge analysis the F.J Mock method requires data on rainfall, climatology, evapotranspiration, water balance, and catchment area.

D. Reliability Discharge

Reability discharge is a predetermined minimum discharge that can be used to fulfill water needs to calculate the reliability discharge used daily rainfall data for ten years. In calculating the reliability discharge, rainfall data is used from 1 (one) rain station, namely Tampa Station. This calculation uses the water balance analysis method from Dr. F.J. Mock based on monthly rainfall data, number of rainy days, evapotranspiration, and hydrological characteristics of the drainage area. Rainfall data required is rainfall data that is exceeded 80% based on the amount of rain each year.

E. Crop Patterns and Planting

A cropping pattern is a pattern of planting plants for one year, a combination of plant sequences. Cropping patterns and arrangements are intended to increase water use efficiency and maximize profits based on the planned cropping pattern. An irrigated area generally has a specific cropping pattern, but a paddy-paddy-Palawija cropping pattern is recommended if there is no suitable pattern in the area. After obtaining water requirements for land management and growth, look for the amount of water needed for irrigation based on cropping patterns and cropping plans from the area observed [12](Directorate General of Irrigation, 1985). The cropping pattern of the current condition is Paddy-Paddy, below is a cropping pattern, including the following:

TABLE IV. Effective Rainfall for Paddy and Palawija Crops

No	Years	Average Monthly Rain (mm)											
		Bulan											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Augst	Sept	Okt	Nov	Dec
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	2013	110,30	84,90	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
2	2014	0,00	0,00	0,00	0,00	0,00	0,00	141,60	207,00	37,30	42,10	231,60	338,00
3	2012	260,90	257,10	237,20	74,80	338,90	81,20	37,20	210,80	29,90	6,20	3,70	90,60
4	2011	395,70	194,30	232,40	416,10	164,30	103,30	50,40	35,50	55,80	93,20	64,30	234,90
5	2018	140,90	277,00	361,70	157,90	152,30	194,20	72,40	24,70	102,20	332,30	193,40	254,50
6	2015	377,30	224,80	456,60	350,10	241,60	84,20	27,50	29,40	2,40	109,50	262,80	290,30
7	2017	311,90	226,40	263,90	332,10	335,00	296,90	104,90	143,30	59,40	185,90	246,10	419,00
8	2020	364,50	211,40	315,80	308,70	167,30	206,60	94,30	184,00	206,10	153,00	333,00	460,00
9	2016	203,60	421,60	590,50	234,90	229,40	165,60	227,50	69,50	196,10	383,90	367,50	433,70
10	2019	497,00	577,00	311,00	759,00	374,00	124,00	179,00	218,00	380,00	140,00	222,00	336,00
Amount		2662,10	2474,50	2769,10	2633,60	2002,80	1256,00	934,80	1122,20	1069,20	1446,10	1924,40	2857,00
Maximum		497,00	577,00	590,50	759,00	374,00	296,90	227,50	218,00	380,00	383,90	367,50	460,00
Average (X average)		266,21	247,45	276,91	263,36	200,28	125,60	93,48	112,22	106,92	144,61	192,44	285,70
Re month (80)		260,90	257,10	237,20	74,80	338,90	81,20	37,20	210,80	29,90	6,20	3,70	90,60
Re day		8,42	9,18	7,65	2,49	10,93	2,71	1,20	6,80	1,00	0,20	0,12	2,92
Days		31	28	31	30	31	30	31	31	30	31	30	31
Re Paddy		5,89	6,43	5,36	1,74	7,65	1,89	0,84	4,76	0,70	0,14	0,09	2,05
Re Palawija		4,20	4,59	3,83	1,25	5,47	1,35	0,6	3,4	0,50	0,1	0,06	1,46

Freddy Barus, Pitojo Tri Juwono, and Runi Asmaranto, "Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province," *International Research Journal of Advanced Engineering and Science*, Volume 6, Issue 3, pp. 388-395, 2021.

TABLE V. Reliability Discharge Recapitulation Calculation.

No	Year	Reliability Discharge (m³/s)						
		Month						
		Jan	Feb	Mar	Apr	May	Jun	Jul
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	2020	0,0000369	0,0000303	0,0000312	0,0000309	0,0000215	0,0000229	0,0000152
2	2019	0,0000441	0,0000533	0,0000338	0,0000586	0,0000374	0,0000234	0,0000232
3	2018	0,0000247	0,0000327	0,0000330	0,0000222	0,0000195	0,0000212	0,0000131
4	2017	0,0000340	0,0000309	0,0000282	0,0000318	0,0000304	0,0000289	0,0000170
5	2016	0,0000281	0,0000419	0,0000467	0,0000289	0,0000261	0,0000220	0,0000232
6	2015	0,0000376	0,0000312	0,0000390	0,0000343	0,0000266	0,0000174	0,0000118
7	2014	0,0000170	0,0000151	0,0000109	0,0000090	0,0000070	0,0000058	0,0000122
8	2013	0,0000230	0,0000210	0,0000120	0,0000099	0,0000077	0,0000063	0,0000049
9	2012	0,0000312	0,0000324	0,0000267	0,0000171	0,0000289	0,0000153	0,0000109
10	2011	0,0000386	0,0000295	0,0000267	0,0000365	0,0000216	0,0000173	0,0000123

TABLE VI. Theoretical Cropping Patterns.

No	Description	Oct		Nov		Dec		Jan	
(1)	(2)	(3)		(4)		(5)		(6)	
1	Period	I	II	I	II	I	II	I	II
2	Paddy planting period I (100%)	LP	LP	PD-1	PD-1	PD-1	PD-1	PD-1	PD-1
3	Paddy planting period II								
4	Paddy planting period III								
5	Water Needs	1,35	1,30	0,69	0,72	0,81	0,84	0,65	0,64
6	S = Paddy field	1,35	1,30	0,69	0,72	0,81	0,84	0,65	0,64
7	T = Secondary = S*1,15	1,55	1,49	0,79	0,83	0,93	0,96	0,75	0,73
8	S = Primary = T*1,11	1,72	1,66	0,87	0,92	1,03	1,07	0,84	0,81
9	Palawija planting period I								
10	Palawija planting period II								
11	Palawija planting period III								
	Area								
12	Q (water needs) (m³/s)	0,007	0,063	0,033	0,035	0,040	0,041	0,032	0,031

No	Description	Feb		Mar		Apr		May	
(1)	(2)	(3)		(4)		(5)		(6)	
1	Period	I	II	I	II	I	II	I	II
2	Paddy planting period I (100%)								
3	Paddy planting period II	LP	LP	PD-2	PD-2	PD-2	PD-2	PD-2	PD-2
4	Paddy planting period III								
5	Water Needs	1,23	0,98	0,38	0,50	0,71	0,72	0,62	0,61
6	S = Paddy field	1,23	0,98	0,38	0,50	0,71	0,72	0,62	0,61
7	T = Secondary = S*1,15	1,41	1,13	0,44	0,57	0,82	0,83	0,72	0,70
8	S = Primary = T*1,11	1,57	1,25	0,49	0,64	0,91	0,92	0,80	0,78
9	Palawija planting period I								
10	Palawija planting period II								
11	Palawija planting period III								
	Area								
12	Q (Water needs) (m³/s)	0,060	0,050	0,020	0,024	0,034	0,035	0,030	0,030

No	Description	Jun		Jul		Aug		Sept	
(1)	(2)	(3)		(4)		(5)		(6)	
1	Period	I	II	I	II	I	II	I	II
2	Paddy planting period I (100%)								
3	Paddy planting period II								
4	Paddy planting period III	LP	LP	PD-3	PD-3	PD-3	PD-3	PD-3	PD-3
5	Water Needs								
6	S = Paddy field								
7	T = Secondary = S*1,15	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
8	S = Primary = T*1,11	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
9	Palawija planting period I	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
10	Palawija planting period II	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
11	Palawija planting period III	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
	Area								
12	Q (water needs) (m³/s)	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000

International Research Journal of Advanced Engineering and Science
ISSN (Online): 2455-9024

F. *Availability of Water and Rainfall*

Figure 4 is a graph of the relationship between the availability of the Paku Beto Reservoir Discharge method F.J. Mock and water availability.

After knowing the objective and constraint functions, the next step is to create a mathematical model for the two parts. Each process will be described in the existing condition with 2 (two) planting seasons.

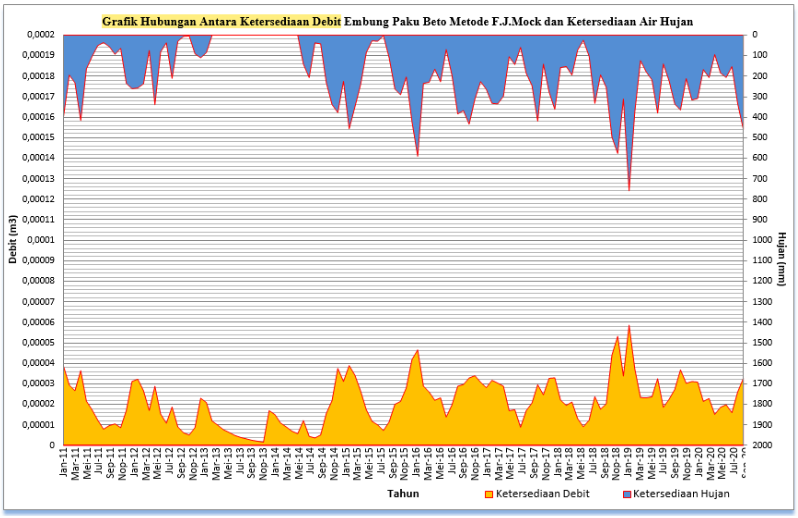

Fig. 4. Graph of the Relationship between the Availability of the Paku Beto Reservoir Discharge Method F.J. Mock and Rainwater Availability.

TABLE VII. Water Availability and Water Demand.

No	Months	Period	Irigation water	Volume				Inflow-outflow
				Water needs (Outflow)		Reability Discharge (Inflow)		
			m³/sec	m³/sec	m³	m³/sec	m³	m³
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Okt	I	0,07	0,07	84.762,03	0,02	24.127,82	-60.634,21
		II	0,06	0,06	81.727,65	0,02	24.127,82	-57.599,83
2	Nov	I	0,03	0,03	43.081,66	0,02	29.120,38	-13.961,28
		II	0,03	0,03	45.134,06	0,02	29.120,38	-16.013,68
3	Dec	I	0,04	0,04	50.734,80	0,03	38.422,30	-12.312,50
		II	0,04	0,04	52.589,07	0,03	38.422,30	-14.166,77
4	Jan	I	0,03	0,03	41.190,76	0,04	48.704,33	7.513,57
		II	0,03	0,03	40.106,37	0,04	48.704,33	8.597,96
5	Feb	I	0,06	0,06	77.316,38	0,03	42.435,46	-34.880,92
		II	0,05	0,05	61.811,65	0,03	42.435,46	-19.376,19
6	Mar	I	0,02	0,02	24.172,56	0,03	43.821,36	19.648,80
		II	0,02	0,02	31.351,28	0,03	43.821,36	12.470,08
7	Apr	I	0,03	0,03	44.677,53	0,03	44.422,80	-2.54,73
		II	0,04	0,04	45.377,88	0,03	44.422,80	-9.55,08
8	May	I	0,03	0,03	39.261,27	0,03	37.435,68	-1.825,58
		II	0,03	0,03	38.257,58	0,03	37.435,68	-8.21,89
9	Jun	I	0,00	0,00	0,00	0,02	29.717,68	29.717,68
		II	0,00	0,00	0,00	0,02	29.717,68	29.717,68
10	Jul	I	0,00	0,00	0,00	0,02	21.987,80	21.987,80
		II	0,00	0,00	0,00	0,02	21.987,80	21.987,80
11	Aug	I	0,00	0,00	0,00	0,02	24.123,41	24.123,41
		II	0,00	0,00	0,00	0,02	24.123,41	24.123,41
12	Sept	I	0,00	0,00	0,00	0,02	25.666,50	25.666,50
		II	0,00	0,00	0,00	0,02	25.666,50	25.666,50
Amount								251.970,98

Freddy Barus, Pitojo Tri Juwono, and Runi Asmaranto, "Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province," *International Research Journal of Advanced Engineering and Science*, Volume 6, Issue 3, pp. 388-395, 2021.

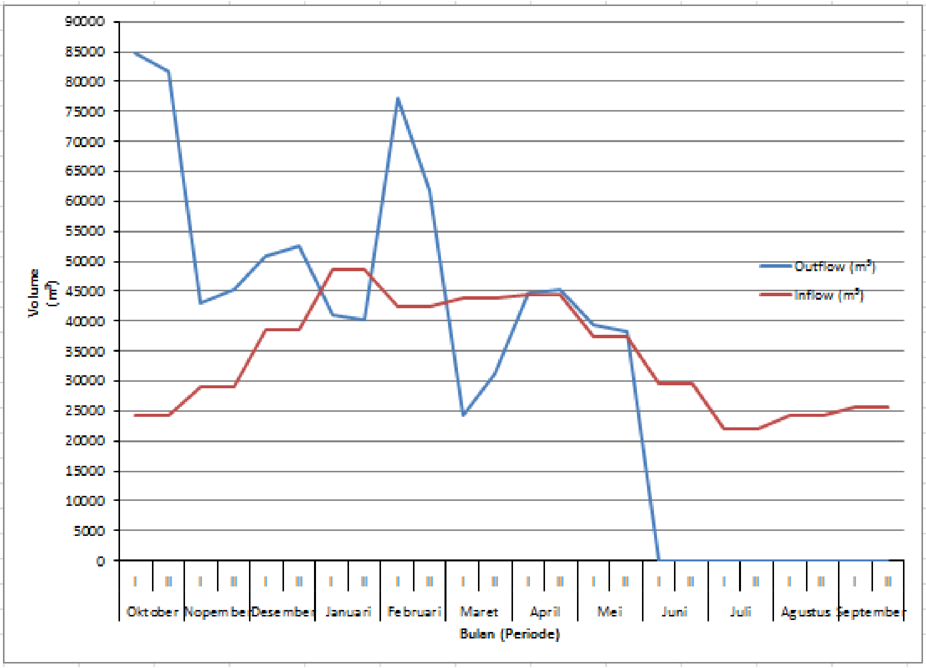

Fig. 5. Water Availability and Water Demand.

TABLE VIII. Water Needs and Availability in Existing Conditions.

Months	No	Paddy Water Needs (m^3/sec)	Water Needs (m^3)	Period	Palawija Water Needs (m^3/sec)	Water Needs (m^3)	Period	Water Availability (m^3)	Water Availability (m^3/detik)	Cultivated Plants
Okt	1	0,07	84.762,03	I	0,00	0,00	I	24.127,82	0,01862	50 ha paddy
	2	0,06	81.727,65	II	0,00	0,00	II	24.127,82	0,01862	
Nov	3	0,03	43.081,66	I	0,00	0,00	I	29.120,38	0,02247	
	4	0,03	45.134,06	II	0,00	0,00	II	29.120,38	0,02247	
Dec	5	0,04	50.734,80	I	0,00	0,00	I	38.422,30	0,02965	
	6	0,04	52.589,07	II	0,00	0,00	II	38.422,30	0,02965	
Jan	7	0,03	41.190,76	I	0,00	0,00	I	48.704,33	0,03758	
	8	0,03	40.106,37	II	0,00	0,00	II	48.704,33	0,03758	
Amount		0,34	439.326,40		0,00	0,00		280.749,67	0,216628	
Feb	9	0,06	77.316,38	I	0,00	0,00	I	42.435,46	0,03274	50 ha paddy
	10	0,05	61.811,65	II	0,00	0,00	II	42.435,46	0,03274	
Mar	11	0,02	24.172,56	I	0,00	0,00	I	43.821,36	0,03381	
	12	0,02	31.351,28	II	0,00	0,00	II	43.821,36	0,03381	
Apr	13	0,03	44.677,53	I	0,00	0,00	I	44.422,80	0,03428	
	14	0,04	45.377,88	II	0,00	0,00	II	44.422,80	0,03428	
May	15	0,03	39.261,27	I	0,00	0,00	I	37.435,68	0,02889	
	16	0,03	38.257,58	II	0,00	0,00	II	37.435,68	0,02889	
Amount		0,28	362.226,13		0,00	0,00		336.230,61	0,259437	
Jun	17	0,00	0,00	I	0,00	0,00	I	29.717,68	0,02293	Rainfed
	18	0,00	0,00	II	0,00	0,00	II	29.717,68	0,02293	
Jul	19	0,00	0,00	I	0,00	0,00	I	21.987,80	0,01697	
	20	0,00	0,00	II	0,00	0,00	II	21.987,80	0,01697	
Aug	21	0,00	0,00	I	0,00	0,00	I	24.123,41	0,01861	
	22	0,00	0,00	II	0,00	0,00	II	24.123,41	0,01861	
Sep	23	0,00	0,00	I	0,00	0,00	I	25.666,50	0,01980	
	24	0,00	0,00	II	0,00	0,00	II	25.666,50	0,01980	
Amount		0,00	0,00		0,00	0,00		202.990,77	0,156629	

G. Farming Analysis

Analysis of farming results is the net income of farmers obtained from farmer receipts minus production costs that have been incurred by farmers per hectare. Farmer income is the amount of production per hectare plant multiplied by the production price of that plant.

The results of the calculation of farming analysis are in the form of net income for each plant in the calculation of the profits to be achieved, as shown in the following table

Freddy Barus, Pitojo Tri Juwono, and Runi Asmaranto, "Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province," *International Research Journal of Advanced Engineering and Science*, Volume 6, Issue 3, pp. 388-395, 2021.

TABLE IX. Results for Existing Cropping Patterns.

No	Type of Irrigation plant	Net Income (per/ha)	Land Area (ha)	Total Income (Rp.)
(1)	(2)	(3)	(4)	(5)
1	Paddy MT 1	31.680.000	8	253.440.000
2	Paddy MT 2	29.680.000	4	118.720.000
Total				372.160.000

V. CONCLUSION

The discharge of filling water in Paku Beto Reservoir which is used to fulfill irrigation water needs for agricultural land in each period is 24,127 m^3 in October, 29,120 m^3 in November, 38,422 m^3 in December, 48,704 m^3 in January, 42,435 m^3 in February, 43,821 m^3 in March, 44,422 m^3 in April, 37,435 m^3 in May, 29,717 m^3 in June, 21,987 m^3 in July, 24,123 m^3 in August, 25,666 in September each period. Based on the volume of the reability discharge and the existing water needs, The discharge of water needs needed to fulfill irrigation water needs on agricultural land in each period is 25,429 m3 and 24,518 m^3 in October, 12,925 m^3 and 13,540 m^3 in November, 15,220 m^3 and 15,777 m^3 in December, 12,357 m^3 and 12,032 m^3 in January, 52,189 m^3 and 41,723 m^3 in February, 16,316 m^3 and 21,162 m^3 in March, 30,157 m^3 and 30,630 m^3 in April, 26,501 m^3 and 25,824 m^3 in May, 32,488 m^3 and 36,736 m^3 in June , 17,328 m^3 and 19,289 m^3 in July, 21,077 m^3 and 21,937 m^3 in August, 21,729 m^3 and 21,117 m^3 in September. From the Analysis of farming results is the net income of farmers obtained. Income in the existing condition is Rp. 372.160.000,-. Thus, it was concluded that at several periods of time there was a water deficit in the reservoir which resulted in the plant's water needs not being fulfilled optimally so that the benefits of plant productivity were not maximized. Therefore, optimization and operation patterns need to be carried out to produce maximum output based on current water availability conditions.

REFERENCES

[1] Badan Pusat Statistik Barito Timur, 2019. Barito Timur Dalam Angka Tahun 2019. Tamiang Layang : Badan Pusat Statistik.

[2] Hilmi, dkk. 2012. Optimasi Pola Operasi Waduk Pelaparado di Kabupaten Bima Propinsi NTB. Tesis. Jurusan Teknik Pengairan, Universitas Brawijaya. Malang.

[3] Ahmad Wahyudi, dkk. 2014. *Studi Optimasi Pola Tanam pada Daerah Irigasi Warujayeng Kertosono dengan Program Linier*. Jurnal Teknik Pomits. Fakultas Teknik Sipil dan Perencanaan, ITS.

[4] Wesli. (2013). Pengoperasian Waduk Melalui Model Optimasi Linear Programming (Studi Kasus Waduk Keuliling Aceh Besar). Teras Jurnal 3(2), pp. 85–94

[5] Soedibyo. 1993. Teknik Bendungan. Pradnya Paramita. Jakarta.

[6] Soemarto, C.D. 1999. Hidrologi Teknik. Erlangga. Jakarta.

[7] Linsley, R. K., dan J. B. Franzini. 1991. Teknik Sumberdaya Air Jilid I. Erlangga. Jakarta.

[8] Wesli. (2013). Pengoperasian Waduk Melalui Model Optimasi Linear Programming (Studi Kasus Waduk Keuliling Aceh Besar). Teras Jurnal 3(2), pp. 85–94.

[9] Soetopo,W. 2010. Operasi Waduk Tunggal. Malang: Citra Malang.

[10] Dinia, A., R. Jayadi., Istiarto, I., 2014. Evaluasi Kinerja Pola Operasi Waduk (POW) Wonogiri. Jurusan Teknik Sipil, Fakultas Teknik Sipil dan Perencanaan, Universitas Islam Indonesia. Yogyakarta.

[11] Limantara, LM dan Soetopo, W. 2010. *Manajemen Sumber Daya Air*. Bandung : Lubuk Agung.

[12] Montarcih, L & Soetopo, W. 2010. *Statistika Terapan*. Citra Malang : Malang

Freddy Barus, Pitojo Tri Juwono, and Runi Asmaranto, "Evaluation of Paku Beto Reservoir Performance to Fulfill Irrigation Water Needs in Rain Funded Area in Paku Beto Village, East Barito Regency, Central Kalimantan Province," *International Research Journal of Advanced Engineering and Science*, Volume 6, Issue 3, pp. 388-395, 2021.