

Simulation of Water Resources Utilization in the Jereweh Watershed, West Sumbawa Regency, Indonesia

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Abstract. This study aims to simulate using water resources in the Jereweh watershed to meet irrigation water needs. From the calculation results of the analysis of the annual average water availability at the Lang Desa Dam of 0.96 m³/sec (29.98 mln m³), the Tiu Bangkemah Embung of 1.53 m³/sec (47.60 mln m³), and the Murus I Embung of 0.06 m³/sec (1.79 million m³).

The optimal allocation of water based on the water balance in the Jereweh watershed system is as follows: cropping pattern MT- I: rice (100%); MT-II: 30% rice + secondary crops (70%); MT-III: beo with a planting intensity of 200%.

It was early planting November I, type of secondary crops: corn with reliability > 80%, namely Lang Desa Weir 88%, Tiu Bangkemah Embung 92% and Murus I Dam 92%.

The total area served is 650 ha: Lang Desa Dam - 300 ha, the Tiu Bangkemah Embung - 300 ha, Murus I Embung - 50 ha.

From the simulation results consists, it is necessary to add water reservoirs (dams) to maximize the performance of existing natural resources facilities in the Jereweh watershed system (there is a deficit of 150 ha). From the results, it can be seen that the value of benefits obtained in the existing condition is Rp. 6,840 bln, while the value of benefits received after the simulation is Rp. 14,82 bln so that the difference in the value of benefits is Rp. 7,98 bln.

Keywords: Irrigation Water Availability; Irrigation Water Needs; Water Balance Simulation.

INTRODUCTION

The availability of water resources is highly dependent on the regulation and management of the water resources themselves [1], [2]. Excessive water exploration of water resources results in reduced water potential in the future, so it is necessary to manage and use water resources as efficiently as possible in order to meet needs [1], [2]. The management of water resources includes water distribution, water supply and water demand [3], [4]. Utilization of water resources is used for agricultural irrigation, so that the development of agricultural facilities is very necessary such as irrigation networks, reservoirs, reservoirs, and weirs are increasingly expected to meet the irrigation needs of agricultural land [5].

Jereweh District is one of the sub-districts in the West Sumbawa Regency, NTB Province. The potential of agricultural land in this area is vast but needs to be utilised optimally. As a result of the large existing rural area, it is necessary to sup-

port the availability of water and the functioning of irrigation networks to drain irrigation water.

People rely on rainwater to meet their irrigation water needs in cultivating their land [6]. The potential for water discharge from the river is abundant in the rainy season, but its utilisation cannot be maximised [7]. For this reason, it is necessary to manage water with zero runoff by storing water during the rainy season as much as possible and using it during the dry season.

One of the existing irrigation infrastructures in Jereweh District is the Lang Desa Dam, built in 1996–1997 with a total area of 1300 ha of standard irrigation. From this area, the irrigation area currently irrigated is around 868 ha, with details of the Lang Desa irrigation area on the right of 411.5 ha and the Lang Desa irrigation area on the left with an area of 456.5 ha, with a planting intensity of 206% [8].

The Lang Desa Irrigation Area's current existence has experienced a performance decline (de-

creased efficiency) [9]. One of the causes is the lack of water supply in the Jereweh River, especially in the Lang Village Dam during MT-II and MT-III. Supporting the creation of optimal irrigation management in Jereweh District and its surroundings, especially Lang Desa requires an effort to supplement and regulate water from upstream to the Lang Desa Dam.

To support the performance of the Lang Desa Dam, in 2019, the Tiu Bangkemah Dam was built, which is located upstream. In 2012 Embung Murus I was constructed downstream of the Lang Desa Dam. The two reservoirs are expected to assist the performance of the Lang Desa Dam in irrigating irrigation water needs.

This study aims to simulate using water resources in the Jereweh watershed to meet irrigation water needs.

The optimisation is carried out on all buildings in the Jereweh watershed system. This simulation produces an optimal pattern of natural resource utilisation. The objectives of this study are 1) To determine the availability of water in the Jereweh watershed system; 2) Knowing the optimal water allocation based on the water balance in the Jereweh watershed system; 3) to know the reliability (reliability) of the Tiu Bangkemah Embung and Murus I Embungs in meeting water needs and supplementation to the Lang Desa Dam system;

Literature review

Rain Data Analysis. The rainfall data collected was selected based on considerations, including the proximity of the location and the similarity of the characteristics of the watershed at the rainfall station to the location and characteristics of the watershed in the reservoir, and the consideration of completeness of the data and sufficient length of the data.

One of the methods to determine the regional average rainfall is the Thiessen Polygon Method with the following (1):

$$d = \frac{A_1 \cdot d_1 + A_2 \cdot d_2 + \dots + A_n \cdot d_n}{A} = \sum_{i=1}^n \frac{A_i \cdot d_i}{A} \tag{1}$$

where A – total area (km²); d – area average rainfall (mm); a_1, a_2, \dots, a_n – rainfall at headings 1, 2, ...,n (mm); A_1, A_2, \dots, A_n – area of influence post 1,2, ...,n (km²).

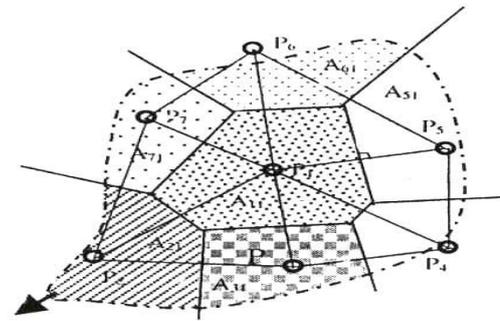


Figure 1 – Thiessen's Polygon Method

Water Availability Analysis. In this study, the runoff rain model used is the NRECA (USA) model developed by Crowfort. The Irrigation Research and Development Center in various drainage areas in Indonesia has widely applied this model. Besides, the model parameters are relatively few and easy to implement and provide satisfactory results reliable. In general, the fundamental equation of this model is formulated as follows (2):

$$Q = P - E + S, \tag{2}$$

where Q – runoff (mm); P – Average rainfall in the watershed (mm); E – Actual evapotranspiration (mm); S – Change in content (difference of water in the soil) (mm).

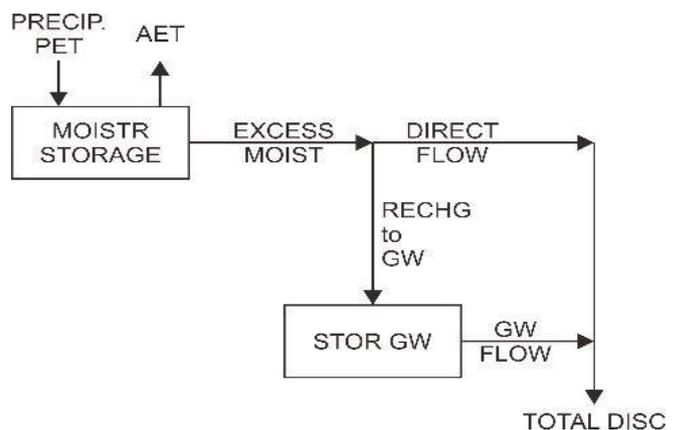


Figure 2 – The schematisation of the NRECA Model

Water Demand Analysis. Analysis of water needs is intended to determine the amount of water needed for irrigation and drinking water for the population so that it will be possible to simulate the reservoir operation to optimise the reservoir.

The amount of water needed by plants in a paddy field is expressed in the following equation (3):

$$NFR = LP + ET_c + P + WLR - R_e, \quad (3)$$

where *NFR* – water demand in paddy fields (mm/day); *LP* – water requirement for land management (mm/day); *ET_c* – plant water requirement (consumptive use) (mm/day); *WLR* – water layer replacement (mm/day); *P* – percolation (mm/day); *R_e*= effective rainfall (mm/day).

Water Balance Analysis. This study analyses the water balance of a reservoir operation simulation in the context of an optimisation study. That aims to find the relationship between reservoir storage volume and reservoir height, irrigation area, cropping patterns and cropping intensity. The reservoir operation simulation is intended to determine the water balance to obtain an optimal development scale. The basic principle of reservoir operation simulation is to use continuity equations (4).

$$S_t = S_{t-1} + I_t - E_t + WR_t + O_t, \quad (4)$$

where *S_t* – volume of reservoir water at time *t*; *S_{t-1}* – reservoir water volume at time *t-1*; *I_t* – volume inflow which enters the reservoir at time *t*; *E_t* – evaporation what happens to the reservoir at time *t*; *WR_t* – plant water requirement at time *t*; *O_t* – volume outflow supplied from the reservoir at time *t*.

METHOD

Research sites. The research area is in Jereweh District, West Sumbawa Regency, NTB. Based on the river area, it is located in the Sumbawa WS in the Jereweh watershed.

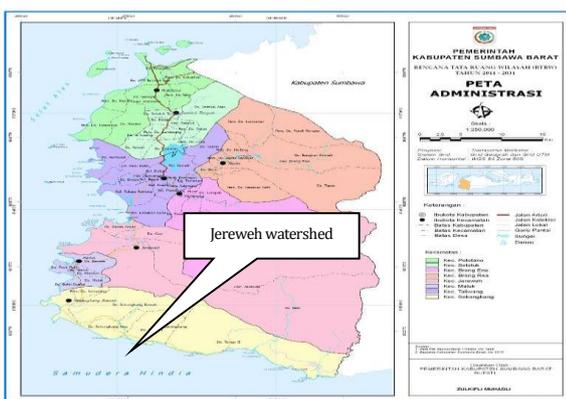


Figure 3 – Research Area Map

Data collection. The data collected in this study are as follows.

1. Topographical data in the form of a site map of the reservoir and the inundation of the Jelenga Reservoir. This data was obtained from the Department of Public Works of West Sumbawa Regency.
2. Hydroclimatological data consists of rain, climate, and discharge data. Rainfall data and climate data were obtained from the BMKG of NTB Province.
3. Data on watersheds and potential irrigation areas are obtained from digital RBI Maps from the Geospatial Information Agency (BIG) or Bakosurtanal.

Data analysis. After the data is collected, the data analysis is carried out. The data analysis carried out in this study is as follows:

1. The *regional average rainfall analysis* aims to determine the rainfall stations that affect the study location. The method of determining the regional average rainfall is calculated by the Thiessen Polygon method.
2. The *data consistency test* was carried out using the RAPS (Rescaled Adjusted Partial Sums) method. This test aims to determine whether the rain data used is still within consistent limits based on the statistical parameter values.
3. **Effective Rain Analysis.** Effective rainfall is rainfall that falls on an area and can be used by plants for their growth.
4. Climatological data is used to calculate the potential *evapotranspiration* that occurs in the study area, and the amount of potential evapotranspiration is calculated using the Penman method (FAO Modification).
5. *Analysis of water availability* was calculated by the Nreca method. The study aims to determine the amount of potential inflow in the reservoir.
6. The *analysis of irrigation water demand* is intended to determine the amount of water needed for irrigation so that it can simulate the operation of the reservoir to optimise reservoirs.
7. The *analysis of the reservoir capacity* of the reservoir is intended to determine the Volume of the effective reservoir in the Jereweh watershed that can be used to meet the needs of irrigation water.
8. *Analysis of the water balance* in the Jereweh watershed focuses on the existing weir building,

the existing reservoir and the planned reservoir in the watershed.

9. *Optimisation of Natural Resources Utilization* in the Jereweh Watershed aims to optimise the use of natural resources by calculating irrigation water use in several buildings in the Jereweh watershed.

RESULTS AND DISCUSSION

Rain Data Analysis

The method used to calculate the regional average rainfall is the Thiessen Polygon method. From the results of plotting the Thiessen Polygon, it can be seen that the influential rain station is the Jereweh Rain Post.

Jan		Feb		Mar		Apr		May		Jun		
I	II											
65	99	62	33	43	47	28	23	3	15	10	11	
Jul		Aug		Sep		Oct		Nov		Dec		Average
I	II											
8	0	0	0	0	13	0	22	35	47	12	57	753

Source : calculation results

Figure 4 – Jereweh Rain Station Average Rain Data

The average annual rainfall in the Jereweh watershed is 753 mm/year. The lowest yearly rain occurred in 2019 at 300.0 mm/year, while the most significant annual rain occurred in 2013 at 2,244 mm/year. From this data, it can be seen that the average yearly rainfall is relatively small, <1,000 mm/year.

Jereweh Rainfall Station	Q/n ^{0.5} (Calculation)	Q/n ^{0.5} (Table)	R/n ^{0.5} (Calculation)	R/n ^{0.5} (Table)	Description
maximum daily rainfall	1.03	< 1.29	1.03	< 1.29	consistent
annual rainfall	0.80	< 1.21	0.91	< 1.21	consistent

Source : calculation results

Figure 5 – Recap of Rain Data Consistency Test Results

From the calculation results of the rain data consistency test using the RAPS method, it can be seen that the Jereweh Station rain data is still within consistent limits so that it can be used for further analysis.

Water Availability Analysis

It is necessary to have flow rate data from observations. The discharge data used in this analysis is the debit recording data at the Lang Desa Dam

for the last ten years. For the calculation of the discharge at the Tiu Bangkemah Embankment and Murus I Reservoir, the method of comparing the area of the catchment area (DTA) was used. The recap of the calculation of water availability is as follows.

Description	Jan		Feb		Mar		Apr		May		Jun	
	I	II										
Bendung Lang Desa	6.34	8.06	7.24	5.77	3.64	5.89	7.99	2.66	2.83	0.61	0.63	0.29
Embung Tiu Bangkemah	3.89	4.94	4.44	3.54	2.24	3.61	4.90	1.63	1.74	0.38	0.38	0.18
Embung Murus I	0.15	0.19	0.17	0.13	0.08	0.14	0.18	0.06	0.07	0.01	0.01	0.01

Description	Jul		Aug		Sep		Oct		Nov		Dec		Average	average
	I	II	(m ³ /sec)	(million m ³)										
Bendung Lang Desa	0.12	0.11	0.06	0.03	0.03	0.02	0.04	0.59	0.19	1.52	1.76	3.46	2.49	78.68
Embung Tiu Bangkemah	0.07	0.07	0.04	0.02	0.02	0.01	0.03	0.36	0.12	0.93	1.08	2.12	1.53	48.27
Embung Murus I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.04	0.08	0.06	1.80

Source : calculation results

Figure 6– Water Availability Calculation Recapitulation

From the calculation results of the analysis of the annual average water availability at the Lang Desa Dam of 0.96 m³/sec (29.98 mln m³), the Tiu Bangkemah Embung of 1.53 m³/sec (47.60 mln m³), and the Murus I Embung of 0.06 m³/sec (1.79 mln m³)

Water Demand Analysis

The existing cropping pattern at the study site is paddy-padi+palawija-bero with an intensity of 200%. In this study, water requirements are calculated by applying the existing cropping pattern with early planting alternatives, namely November 1, November 2, December 1, and December 2.

No.	Monthly	early planting							
		Nop 1		Nop 2		Des 1		Des 2	
		NFR	DR	NFR	DR	NFR	DR	NFR	DR
1	Jan-1	1.05	1.62	1.47	2.28	1.29	1.99	1.15	1.77
2	Jan-2	0.72	1.11	1.13	1.74	1.24	1.92	1.24	1.92
3	Feb-1	0.71	1.09	1.07	1.65	1.20	1.85	1.23	1.90
4	Feb-2	0.89	1.38	1.43	2.21	1.46	2.25	1.22	1.89
5	Mar-1	0.45	0.69	1.08	1.67	1.26	1.95	1.40	2.16
6	Mar-2	0.26	0.41	0.79	1.22	1.13	1.75	1.28	1.97
7	Apr-1	0.31	0.48	0.47	0.72	0.82	1.26	1.15	1.77
8	Apr-2	0.51	0.79	0.45	0.69	0.90	0.77	0.84	1.29
9	May-1	0.62	0.96	0.55	0.85	0.45	0.69	0.49	0.75
10	May-2	0.62	0.96	0.68	1.05	0.53	0.82	0.44	0.69
11	Jun-1	0.62	0.96	0.67	1.04	0.65	1.00	0.53	0.82
12	Jun-2	0.52	0.81	0.69	1.06	0.64	0.99	0.64	0.99
13	Jul-1	0.03	0.03	0.66	1.02	0.72	1.12	0.65	1.00
14	Jul-2	0.03	0.03	0.24	0.24	0.67	1.03	0.73	1.12
15	Aug-1	Bero	Bero	0.09	0.09	0.25	0.25	0.69	1.06
16	Aug-2	Bero	Bero	Bero	Bero	0.09	0.09	0.25	0.25
17	Sep-1	Bero	Bero	Bero	Bero	Bero	Bero	0.09	0.09
18	Sep-2	Bero	Bero	Bero	Bero	Bero	Bero	Bero	Bero
19	Oct-1	Bero	Bero	Bero	Bero	Bero	Bero	Bero	Bero
20	Oct-2	Bero	Bero	Bero	Bero	Bero	Bero	Bero	Bero
21	Nov-1	0.75	1.16	Bero	Bero	Bero	Bero	Bero	Bero
22	Nov-2	1.09	1.69	0.85	1.31	Bero	Bero	Bero	Bero
23	Dec-1	1.08	1.67	1.23	1.90	0.82	1.27	Bero	Bero
24	Dec-2	1.12	1.73	1.26	1.94	1.15	1.78	0.82	1.27
Maximum		1.12	1.73	1.47	2.28	1.46	2.25	1.40	2.16
Average		0.63	0.98	0.82	1.26	0.83	1.26	0.82	1.26

Source : calculation results

Description:
 : crop season I (paddy)
 : crop season II (paddy+palawija)
 : crop season III (bero)

Figure 7 – Water Availability Calculation Recapitulation

Reservoir Capacity

Calculation of the effective water storage capacity is very necessary to determine the amount of water that must be stored in the reservoir so that when the river flows are small or dry, the water from the reservoir can be released as a substitute for the specified water needs to meet irrigation water needs.

The data for the reservoir capacity of the Tiu Bangkemah Embung is as follows: Elv. riverbed = +54.00 m; Elv. dead pool= +57.00 m; Elv. spillway= +63.00 m; Elv. top of reservoir= +66.00 m; Gross storage volume= 278.803.11 m³; Dead storage volume= 14,263.35 m³; Effective storage volume= 264,539.77 m³.

The data for the storage capacity of Murus I Embung is as follows: Elv. riverbed= +27.00 m; Elv. dead pool= +30.00 m; Elv. spillway= +37.00 m; Elv. top of reservoir= +39.00 m; Gross storage volume= 108,278.45 m³; Dead storage volume= 14,059.20 m³; Effective storage volume= 94,219.26 m³.

Water Balance Analysis

To determine the ability of each building to meet irrigation water needs in the Jereweh watershed, a thorough calculation of the existing buildings is carried out.

Lang Desa Dam Water Balance Analysis. Analysis of the water balance of the Lang Desa Dam, the existing condition is a condition where the Tiu Bangkemah Embung upstream of the weir does not yet exist. The calculation of water availability is based on the calculation results above. With a catchment area of 53.56 km², an annual inflow potential of 77.59 mln m³ is obtained with an average semi-monthly discharge of 2.5 m³/sec. The existing cropping pattern is paddy-paddy+plw-bero. A recap of the calculation results can be seen in Figure 8.

Description	plan type	early planting							
		Nov. 1		Nov. 2		Des. 1		Des. 2	
irrigation area		300 Ha		300 Ha		300 Ha		300 Ha	
crop season I	Paddy	300	100%	300	100%	300	100%	300	100%
	Palawija	0	0%	0	0%	0	0%	0	0%
crop season II	Paddy	90	30%	90	30%	90	30%	90	30%
	Palawija	210	70%	210	70%	210	70%	210	70%
crop season III	Paddy	0	0%	0	0%	0	0%	0	0%
	Palawija	0	0%	0	0%	0	0%	0	0%
intensity		200%		200%		200%		200%	
reability		88%		83%		79%		79%	

Source : calculation results

Figure 8 – Recap of Water Balance Calculation Results Weir Lang Village

From the water balance analysis results consists, the area that can be irrigated by the Lang Weir in the Existing Village is 300 ha, with the initial planting of November 1. The total area of Lang village is 800 ha, so there is still a deficit of 500 ha. For this reason, it is necessary to have other water structures in the Jereweh watershed system to assist the performance of the Lang Desa Dam. One of the existing buildings in the Jereweh watershed system is the Tiu Bangkemah Embung and Murus I Dam, so it is necessary to calculate the influence of the existence of the two reservoirs in helping the performance of the Lang Desa Dam.

Water Balance Analysis of the Tiu Bangkemah Reservoir. The recapitulation of the simulation results of the reservoir operation for the rice-paddy+palawija-bero cropping pattern can be seen in Figure 9.

Description	plan type	early planting							
		Nov. 1		Nov. 2		Des. 1		Des. 2	
irrigation area		300 Ha		300 Ha		300 Ha		300 Ha	
crop season I	Paddy	300	100%	300	100%	300	100%	300	100%
	Palawija	0	0%	0	0%	0	0%	0	0%
crop season II	Paddy	90	30%	90	30%	90	30%	90	30%
	Palawija	210	70%	210	70%	210	70%	210	70%
crop season III	Paddy	0	0%	0	0%	0	0%	0	0%
	Palawija	0	0%	0	0%	0	0%	0	0%
intensity		200%		200%		200%		200%	
reability		92%		75%		75%		79%	

Source : calculation results

Figure 9 – Recap of Water Balance Calculation Results Embung Tiu Bangkemah

The simulation results show that the selected cropping pattern is paddy-paddy+palawija-bero, which has the most considerable planting intensity of 200%, and the irrigated area is 300 ha with a statistical reliability level of 92%.

Water Balance Analysis of the Tiu Bangkemah Reservoir. The recapitulation of the simulation results of the reservoir operation for the rice-paddy+palawija-bero cropping pattern can be seen in Figure 10.

Awal Tanam		Nov. 1		Nov. 2		Des. 1		Des. 2	
Luas Areal		50.00 Ha		50.00 Ha		50.00 Ha		50.00 Ha	
Pola tanam									
MT I	Padi	50.00	100%	50.00	100%	50.00	100%	50.00	100%
MT II a	Padi	15.00	30%	15.00	30%	15.00	30%	15.00	30%
MT II b	Plw	35.00	70%	35.00	70%	35.00	70%	35.00	70%
MT III	Plw	0.00	0%	0.00	0%	0.00	0%	0.00	0%
Intensitas		200%		200%		200%		200%	
Keandalan		92%		83%		83%		71%	

Sumber : Hasil Perhitungan

Figure 10 – Recap of Water Balance Calculation Results Murus I

The simulation results show that the selected cropping pattern is rice–paddy+palawija–bero, which has the most considerable planting intensity of 200%. The irrigated area is fulfilled by 50 ha with a statistical reliability level of 92%.

Jereweh Watershed Water Balance Analysis

Existing Condition (Weir Lang Desa). Figure 11 shows that the Lang Desa Dam's capacity can only serve an area of 300 ha. This condition is still far from the current location of 800 ha, experiencing a deficit of 500 ha, so other water storage buildings are needed to assist the performance of the Lang Desa Weir.

Description	plan type	early planting	
		Nov. 1	
irrigation area		300	Ha
crop season I	Paddy	300	100%
	Palawija	0	0%
crop season II	Paddy	90	30%
	Palawija	210	70%
crop season III	Paddy	0	0%
	Palawija	0	0%
intensity		200%	
reability		88%	

Figure 11 – Recap of the calculation of the water balance in the existing Jereweh watershed

Optimization Conditions (Lang Desa Dam + Tiu Bangkemah Embung + Murus I Reservoir). Figures 12a shows that Embung Tiu Bangkemah can supply irrigation services covering an area of 300 ha and Embung Murus I covering an area of 50 ha. The total area added is 350 ha.

Figure 12.a - Water Balance Calculation Results of Embung Tiu Bangkemah			Figure 12.b - the calculation of the water balance of the Jereweh Watershed Optimization Results				
Description	plan type	early planting		Description	plan type	early planting	
		Nov. 1				Nov. 1	
irrigation area		300	Ha	irrigation area		650	Ha
crop season I	Paddy	300	100%	crop season I	Paddy	650	100%
	Palawija	0	0%		Palawija	0	0%
crop season II	Paddy	90	30%	crop season II	Paddy	195	30%
	Palawija	210	70%		Palawija	455	70%
crop season III	Paddy	0	0%	crop season III	Paddy	0	0%
	Palawija	0	0%		Palawija	0	0%
intensity		200%		intensity		200%	
reability		92%		reability		92%	

a)

b)

Figure 12 – Recap of the calculation of the water balance: a) Bangkemah Tiu Reservoir b) Murus I Embung I

Figure 13 shows the total irrigation area that can be served by the three existing natural resources infrastructure in the Jereweh watershed (Ben-

dung Lang Desa, Embung Tiu Bangkemah and Embung Murus I) is 650 ha.

Description	plan type	early planting	
		Nov. 1	
irrigation area		650	Ha
crop season I	Paddy	650	100%
	Palawija	0	0%
crop season II	Paddy	195	30%
	Palawija	455	70%
crop season III	Paddy	0	0%
	Palawija	0	0%
intensity		200%	
reability		92%	

Figure 13 – Recap of the calculation of the water balance of the Jereweh Watershed Optimization Results

This condition is still experiencing a deficit of 150 ha. Thus, the existence of Embung Tiu Bangkemah and Embung Murus I have yet to be able to meet all the needs of the irrigation area in Lang Desa, so several other water structures (dams) are needed.

Value of Economic Benefits

After calculating the water balance analysis and obtaining the reservoir's optimal capacity, the project's economic benefits can be calculated. The value of the advantages is obtained by calculating the value of the benefits in the condition before and after the reservoir is built.

From the above calculation results, it can be seen that the value of the benefits obtained in the existing condition is Rp. 6,84 bln, while the value of the benefits obtained after optimisation is Rp. 14,82 bln, so a breakdown of the value of the benefits is Rp. 7,98 bln. In other words, there is an increase in agricultural production income from before optimisation to after optimisation.

CONCLUSIONS

From the results of the analysis and discussion, it can be concluded as follows:

1. The average annual water availability at Lang Desa Dam is 0.96 m³/s (29.98 mln m³), Tiu Bangkemah Embung is 1.53 m³/sec (47.60 mln m³), and Murus I Embung is 0.06 m³/sec (1.79 mln m³).
2. The optimal allocation of water based on the water balance in the Jereweh watershed system is as follows:

- Planting start: November 1;
- Cropping pattern: MT-I: rice (100%); MT-IIa: rice (30%); MT-IIb: palawija (70%); MT-III: bero;
- Planting Intensity: 200%;
- Weir Lang Village: 300 ha; Embung Tiu Bangkemah: 300 ha; Murus I: 50 ha; Total area served: 650 ha.

3. The reliability value (reliability) of the simulation results is > 80%, so it can be concluded that the simulation was carried out with the following details: Weir Lang Village 88%; Embung Tiu Bangkemah 92%; Murus I 92%.

From the analysis that has been done in this study, it can be concluded that:

1. The suggested cropping pattern to be applied to the Lang Desa Irrigation Area is rice – paddy+palawija – bero with early planting of November 1. By using this cropping pattern, it gives

optimal results according to the simulation results.

2. The implementation of water supply to irrigation areas must be monitored appropriately and correctly. So that the existence of the existing reservoir can be maximally useful to improve the welfare of the people around the reservoir.

3. There is a need for additional water reservoirs (dams) to maximise the performance of existing natural resources in the Jereweh watershed system, considering that the current capacity is only able to irrigate an area of 650 ha from the current size of 800 ha, meaning that there is a deficit of 150 ha.

4. With the addition of several other natural resource buildings, it is expected to optimise the existing area in terms of location, cropping patterns, and cropping intensity.

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