INDONESIAN JOURNAL OF MULTIDISCIPLINARY SCIENCE

P-ISSN: 2808-5957
E-ISSN: 2808-6724

Optimization of Meninting Dam water utilization to meet Irrigation, Raw Water, and Micro Hydro Power Plant potential needs

Ni Ketut Laksmi Grahestika[*], Universitas Mataram, Indonesia
Ery Setiawan, Universitas Mataram, Indonesia
Heri Sulistiyono, Universitas Mataram, Indonesia

[*]Email for Correspondence: grahestika@gmail.com

Keywords:

annual benefit value

Meninting Dam

optimization

ABSTRACT

The construction of the Meninting Dam located in West Lombok Regency, was motivated by the unequal supply of water on Lombok Island. The Meninting Dam was built with the aim of providing irrigation water to Sesaot, Penimbung, and Ketapang Irrigation Area. Apart from that, it is also to supply raw water needs and is used for electricity generation. In fulfilling these goals, it is necessary to carry out careful calculations and use water optimally in an effort to meet these needs. This research aims to obtain optimization results from water utilization with the objective function in the form of maximum profit with a decision variable in the form of optimal irrigated land area and to determine the annual benefit value from dam water use. Optimization analysis is carried out using program Solver in Microsoft Excel. In calculating water availability, Orong Atas AWLR data is used with an area comparison formula. Meanwhile, in calculating the need for irrigation water, several alternatives were tried based on the start of different planting seasons. Based on optimization calculations using Solver, the optimum area was obtained at 1065,29 ha in Sesaot Irrigation Area, 454 ha in Penimbung Irrigation Area, and 40 ha in Ketapang Irrigation Area with a planting intensity for each irrigation area of 300% and reliability of the reservoir at the November I planting season was 80,42%. The value of annual benefits obtained in one year from the productivity of paddy and secondary crops, raw water, and electricity is IDR 105.168.334.600,00.

This is an open access article under the CC BY-SA license.

INTRODUCTION

Water is a natural resource that has a very important role in human life and its survival. Water is used for several needs, such as for meeting basic daily needs, agriculture, use for business or non-business activities, and public interests (Rini, 2022). The availability of water resources can spur economic growth in an area so it must be managed well (Asdak & Salim, 2006).

The agricultural sector in the West Nusa Tenggara region of Indonesia supports economic growth of 21,39%. This indicates that the productivity of the agricultural sector will greatly influence economic growth in West Nusa Tenggara, including the West Lombok Regency so that productivity needs to be increased. To increase productivity results, one of the important influencing factors is water, including the occurrence of rain (Yasa et al., 2021).

Refers to an update on the development of drought disaster in West Nusa Tenggara Province that the rainfall that occurred in 2023 was classified as low, so attention needs to be paid to avoid water crisis. The occurrence of a water crisis can also be caused by unequal water availability over place and time (Ajudiya et al., 2024), one of which occurs on Lombok Island. Water availability in the western part of Lombok Island, including the Meninting Watershed, is relatively sufficient, while the southern part of Lombok Island, especially the Mujur Komplek Irrigation Area, has quite large area potential but water availability is very limited. With these problems, a dam was built, namely the Meninting Dam.

The purpose of building this dam is to balance water potential and agricultural area potential on Lombok Island by providing water for the Meninting Dam irrigation service area, namely the Penimbung,

Ketapang, and Sesaot Irrigation Area. Irrigation water needs to be balanced with water availability. Shifting the start of planting can be done with various alternative planting seasons so that the one that produces the highest profit is chosen, such as in the Batu Tegi Reservoir research, the most optimal results were obtained at the start of planting in January I with the highest annual economic profit (Setiawan et al., 2017), whereas research at the Leuwikeris Dam carried out reservoir optimization and obtained maximum benefit optimization results occurring in the first year of operation (Irawan et al., 2023). Apart from the agricultural sector, the Meninting Dam is also expected to be able to overcome the problem of decreasing spring water discharge to meet raw water needs, and outflow discharge from irrigation and raw water supplies can also be used for power generation.

The aim of this research is to analyze the availability and need for water to fulfill irrigation water, raw water and power generation at the Meninting Dam and to optimize it based on reservoir storage conditions to obtain optimal results and maximum annual benefit value from water use at the Meninting Dam. This research contributes to understanding the effectiveness of utilizing water resources from the Meninting Dam. By conducting an optimization study, the management of water availability in dams can be utilized optimally and have higher economic benefits. Apart from that, these findings can provide information to policy makers and stakeholders in managing water availability in the Meninting Dam to improve agricultural land functions, meet raw water needs and electrical energy potential and support sustainable water supply efforts in West Nusa Tenggara. By understanding reservoir management patterns, stakeholders can ensure that reservoir operations can run effectively and optimally with regard to water distribution (Tang et al., 2024). Because it is very important to accurately calculate current water demand and availability so that current and future changes in demand and availability can be investigated and managed (Sulistiyono & Lye, 2010).

METHOD

Administratively, the Meninting Reservoir is situated in the Gunung Sari and Lingsar District of the West Lombok Regency, within the West Nusa Tenggara Province, Indonesia. The reservoir is built on the Meninting River in the Meninting Watershed. Figure 1 illustrates the map of Meninting Dam.

The method used in this research is the numerical analysis method. The numerical method is used to calculate water availability at the Meninting Dam and water needs systematically (Cholik et al., 2025). Furthermore, in the optimization, a linear programming model was used with the help of the Microsoft Excel Solver program (Zabadi, 2023).

Reservoir Water Availability

Water availability is calculated using discharge data from the nearest AWLR (Automatic Water Level Recorder), namely Orong Atas AWLR and Penimbung Weir. The source of information regarding recorded AWLR debit data is obtained from secondary data recorded at the relevant ministries or institutions. Because the catchment areas of the Orong Atas AWLR and Meninting Dam are different, the discharge value at Meninting Dam can be found using the catchment area comparison method (Triatmodjo, 2008), with the equation presented as follows:

$$Qa = \frac{Aa}{Ab} \text{ x } Qb$$

Information:

Qa = Discharge at the station being searched for (in the same watershed as station B)

Qb = Known debit at station B

Aa = Watershed area at station A (km^2)

Ab = Watershed area at station B (km^2)

Irrigation Water Requirement

Water requirements for the agricultural sector are determined by applying irrigation planning standards based on the Standard Irrigation Planning Criteria-01 (Arif et al., 2024) by considering evaporation requirements, water loss, and plant water requirements (Sosrodarsono & Takeda, 2003). Rainfall data impact the amount of effective rainfall obtained from the Gunung Sari, Sesaot, and Bertais ARR, spanning 10 years from 2014 to 2023.

The existing cropping pattern in the three Meninting Dam Irrigation Areas, namely in the Sesaot Irrigation Area, is paddy-paddy/secondary crops-secondary crops, while the planting pattern in Penimbung and Ketapang Irrigation Area is paddy-paddy-secondary crops. The type of secondary crops is corn. Then the analysis was tried by shifting the start of planting, namely November I, November II, and December I.

The equations commonly used in calculating water requirements during land preparation are as follows (KP-01, 2013):

$$IR = M \left(\frac{e^k}{e^k - 1}\right)$$

Information:
IR = Irrigation water requirements at the paddy field level (mm/day)
M = Water requirement to replace water loss due to evaporation and percolation in saturated paddy fields (mm/day)

Raw Water Requirement and Water Requirement for Micro Hydro Power Plants

Increasing population growth in an area affects the amount of water availability needed, including the need for raw water and electrical energy (Bachtiar et al., 2023; Mulyawati et al., 2024). In the context of this study, for the amount of raw water requirements and water requirements for micro hydro power plants, secondary data sourced from related institutions is used. The amount of raw water requirement designated at 0,15 m^3/s and the amount of electrical energy produced from reservoir utilization is 2,032,320.00 kWh. This requirement was derived from a report by the River Basin Organization of Nusa Tenggara I.

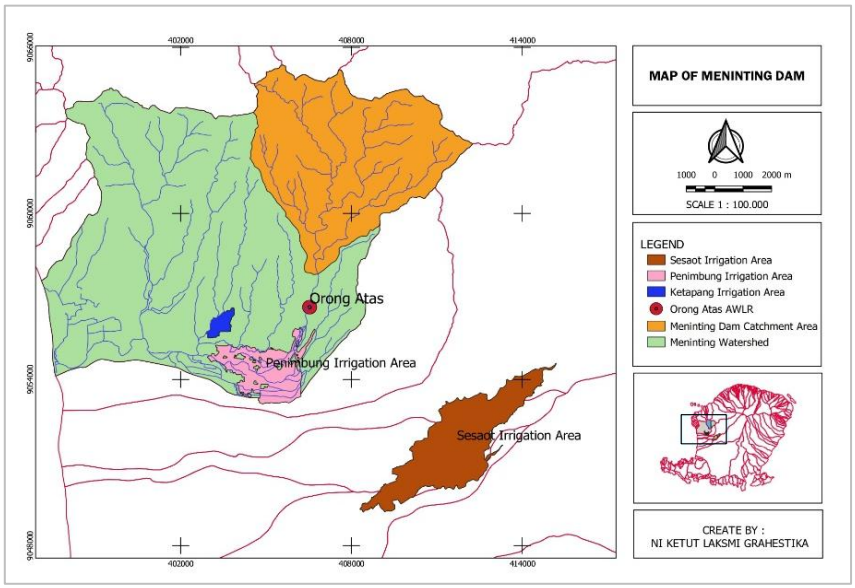

Figure 1. Map of Meninting Dam

Simulation Calculations and Optimization of Reservoir Operations

Reservoir operation simulation calculations were carried out to determine the capacity of the reservoir to meet water needs and control water availability (Agastya et al., 2024). Reservoir operation simulations in the context of optimization aim to determine the relationship between reservoir storage volume, reservoir elevation, irrigation area, planting patterns, planting intensity and other water needs (Jalaluddin et al., 2022). Furthermore, optimization is carried out from the inflow and outflow so that the maximum planting area that can be planted is known based on the reservoir storage volume by taking into account other water needs. The area of planting from the optimization results will determine the economic benefits obtained (Budianto et al., 2022; Nait et al., 2022).

In calculating the change in storage capacity, the reservoir storage continuity equation is used (McMahon & Mein, 1978). By using the formula:

$$S_{t+1} = S_t + Q_t - D_t - E_t - L_t$$

Information:
t = Time period used
S_{t+1} = Reservoir storage at the end of period t (m^3)
S_t = Reservoir storage at the beginning of period t (m^3)
Q_t = Inflow during period t (m^3)
D_t = Needs during period t (m^3)
E_t = Evaporation during period t (m^3)
L_t = Water loss due to leaks and seepage during period t (m^3)

Based on reservoir storage simulations, the probability of failure and reservoir reliability can be obtained. Calculation of reservoir reliability is interpreted as the level of success of reservoir operation within a certain time interval to meet the planned needs. By using the formula:

Probability of reliability = 100% - Probability of failure

Probability of failure = (Number of failed periods / Total number of periods) x 100%

Optimization for reservoir operations is generally used to obtain the best solution (Kafiansyah et al., 2019). Optimization is closely related to maximization but with limitations. In preparing an optimization model, there are three important stages (Samosir et al., 2015). The three stages are identifying objective functions, decision variables, and constraint functions.

This dam optimization calculation will ultimately achieve optimal results with the following variables:

1) The objective function in optimization is to maximize profits based on the selected alternative.
2) The decision variable is the planting area of each plant for each planting season in each irrigation area.
3) The constraint function is the availability of water and the total area of irrigated land that can be planted. The equation for the constraint function is provided below.
   a) Irrigation area

$$X_{ijk} \leq AI$$

   Information:
   X = Irrigation area resulting from optimization
   i = Specific irrigation area (Sesaot, Penimbung, Ketapang Irrigation Area)
   j = Specific planting season (I, II, III) (four months per period in one year, MT)
   k = Certain types of plants (paddy and secondary crops)
   AI = Available irrigation area

   b) Storage volume of the reservoir

$$S_{max} \geq S \geq S_{min}$$

   Information:
   S = Storage conditions of the reservoir in period t (m^3)
   S_{max} = Maximum storage of the reservoir (m^3)
   S_{min} = Minimum storage of the reservoir (m^3)

   c) Reliability level $\geq 0,80$
   Failure level $\leq 0,20$

RESULTS AND DISCUSSION

Water Availability Analysis

Water availability analysis is carried out to obtain inflow at the review location. The observation discharge data used is AWLR discharge data located in the related study area, namely the Orong Atas AWLR in the form of semi-monthly discharge data for 2014 – 2023 obtained from related agencies and summed up with the intake discharge data of the dam located upstream of the Orong Atas AWLR, namely the Penimbung Weir. Because the catchment area of the Meninting Reservoir and AWLR Orong Atas is different, it is necessary to make a comparison of the area. The results of the inflow of the Meninting Reservoir can be seen in the following table.

Table 1. Meninting Reservoir inflow discharge (m^3/second)

Period	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
JAN I	6,90	2,20	3,17	1,64	3,13	3,02	2,81	8,72	2,55	5,71
JAN II	4,85	0,62	3,57	2,68	17,54	1,34	1,27	9,01	5,00	1,71
FEB I	4,95	1,57	5,80	10,41	2,10	1,68	3,76	30,37	9,19	9,17
FEB II	1,11	1,97	2,14	2,39	2,51	1,80	6,04	9,24	9,40	12,16
MAR I	0,56	3,30	3,07	2,57	1,55	3,45	4,81	7,67	6,37	20,52
MAR II	1,42	2,89	3,17	3,21	2,10	3,25	5,98	6,98	5,34	7,40
APR I	0,97	4,66	5,41	3,93	3,04	3,78	6,79	4,16	6,41	16,47
APR II	1,93	4,62	2,45	2,61	2,89	3,46	1,89	1,94	9,55	13,83
MAY I	1,41	2,07	2,50	3,15	1,53	2,66	2,04	1,58	3,33	12,76
MAY II	0,88	0,91	3,00	4,12	2,04	1,60	3,08	1,19	3,63	2,29
JUN I	0,43	2,66	2,21	3,10	0,17	1,35	2,45	1,34	4,07	0,89
JUN II	0,25	0,34	3,13	2,64	1,06	8,44	0,77	5,57	5,32	0,77
JUL I	0,12	0,15	2,40	1,62	0,50	0,49	0,99	4,88	2,06	2,57
JUL II	0,03	0,02	4,96	0,94	0,34	0,37	1,11	1,06	1,18	1,27
AUG I	0,26	0,02	1,28	0,65	0,36	0,00	0,98	2,35	2,58	0,52
AUG II	0,02	0,02	1,15	0,53	0,39	0,00	1,18	4,85	4,45	0,46
SEP I	0,03	0,02	1,01	0,25	0,34	0,00	1,09	2,22	2,55	0,65
SEP II	0,08	0,00	7,30	0,89	0,51	0,00	0,93	4,95	4,38	0,89
OCT I	0,02	0,00	6,71	3,62	0,31	0,00	5,43	1,34	13,03	0,36

Period	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
OCT II	0,00	0,05	12,46	2,64	0,19	0,00	3,23	5,57	13,45	0,44
NOV I	0,17	1,82	8,36	4,20	4,80	0,51	3,92	16,79	7,98	1,47
NOV II	1,03	4,83	4,81	7,61	6,95	2,13	6,13	6,80	6,86	8,18
DEC I	1,99	7,97	3,75	2,50	3,94	2,56	5,08	7,63	3,89	22,14
DEC II	4,07	6,47	2,37	5,22	1,75	4,56	5,41	4,42	3,48	9,88

Irrigation Water Needs Analysis

Factors taken into account in analyzing irrigation water needs include effective rainfall, irrigation efficiency, percolation, evapotranspiration, water layer replacement, water need for land preparation, start of the planting season, and planting patterns. In this study, calculations of irrigation needs and evapotranspiration were carried out in each irrigation area that received irrigation water supplies from the Meninting Dam.

Table 2. The recapitulation of water needs in the three irrigation service areas of the Meninting Dam at the beginning of planting is different

No.	Month	Period	Number of days	Irrigation Water Needs m^3/half month/ha		
				NOV I	***NOV II***	***DEC I***
1	JAN	I	15	5.895,96	6.011,00	6.344,57
2		II	16	4.342,59	4.465,30	4.588,02
3	FEB	I	14	4.963,64	5.181,02	5.289,71
4		II	14	2.673,25	6.035,07	6.252,45
5	MAR	I	15	5.333,54	2.098,11	5.429,64
6		II	16	5.453,32	5.453,32	2.090,26
7	APR	I	15	4.921,88	4.921,88	4.921,88
8		II	15	4.408,85	4.923,42	4.923,42
9	MAY	I	15	4.906,36	4.844,97	5.306,18
10		II	16	5.822,36	5.756,89	5.691,41
11	JUN	I	15	5.234,62	5.355,48	5.297,79
12		II	15	2.899,77	5.333,06	5.453,92
13	JUL	I	15	1.948,76	2.859,86	5.313,29
14		II	16	1.908,77	2.655,52	3.217,91
15	AUG	I	15	3.055,24	2.091,06	2.673,18
16		II	16	4.398,95	3.370,49	2.342,03
17	SEP	I	15	4.979,45	4.823,76	3.630,19
18		II	15	4.333,17	4.592,64	4.436,96
19	OCT	I	15	1.318,27	4.149,98	4.427,60
20		II	16	-	841,18	3.861,68
21	NOV	I	15	6.531,51	-	-
22		II	15	6.716,12	6.716,12	-
23	DEC	I	15	6.480,76	6.480,76	6.480,76
24		II	16	6.252,59	6.618,15	6.618,15
Average				4,365.82	4,399.13	4,357.96

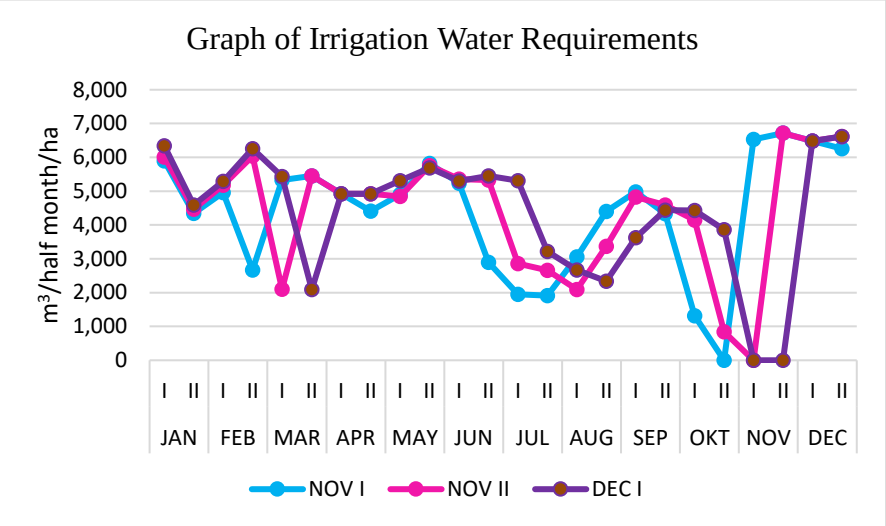

Figure 2. Total irrigation water needs in the three Meninting Dam irrigation service areas

Raw Water and Micro Hydro Power Needs Analysis

The construction of the Meninting Reservoir aims to supply raw water of 0,15 m^3/s to Batu Layar and Gunung Sari District. The large amount of raw water and micro hydro power plants requirements can be seen in Table 3 below.

Table 3. Water requirements for raw water and micro hydro power plant

No.	Month	Period	Number of days	Raw Water Needs		Micro Hydro Power Plant Needs		
				m^3/s	*m^3/half a month*	*m^3/s*	*m^3/ half a month*	*E (kWh)*
1	JAN	I	15	0,15	194.400	2,175	2.818.800	
2		II	16	0,15	207.360	2,175	3.006.720	
3	FEB	I	14	0,15	181.440	2,175	2.630.880	
4		II	14	0,15	181.440	2,175	2.630.880	
5	MAR	I	15	0,15	194.400	2,175	2.818.800	
6		II	16	0,15	207.360	2,175	3.006.720	
7	APR	I	15	0,15	194.400	2,175	2.818.800	
8		II	15	0,15	194.400	2,175	2.818.800	
9	MAY	I	15	0,15	194.400	2,175	2.818.800	
10		II	16	0,15	207.360	2,175	3.006.720	
11	JUN	I	15	0,15	194.400	2,175	2.818.800	
12		II	15	0,15	194.400	2,175	2.818..800	
13	JUL	I	15	0,15	194.400	2,175	2.818.800	2.032.320,00
14		II	16	0,15	207.360	2,175	3.006.720	
15	AUG	I	15	0,15	194.400	2,175	2.818.800	
16		II	16	0,15	207.360	2,175	3.006.720	
17	SEP	I	15	0,15	194.400	2,175	2.818.800	
18		II	15	0,15	194.400	2,175	2.818.800	
19	OCT	I	15	0,15	194.400	2,175	2.818.800	
20		II	16	0,15	207.360	2,175	3.006.720	
21	NOV	I	15	0,15	194.400	2,175	2.818.800	
22		II	15	0,15	194.400	2,175	2.818.800	
23	DEC	I	15	0,15	194.400	2,175	2.818.800	
24		II	16	0,15	207.360	2,175	3.006.720	
Average					197.100		2.857.950,00	
Total					4.730.400,00			

Source: BBWS Nusa Tenggara I

Results of Reservoir Operation Optimization in Meninting Reservoir

Based on the inflow and outflow (irrigation water, raw water, micro hydro power plant needs, and evaporation) inputted in the simulation calculation, a program was run in Solver Microsoft Excel to obtain the decision variable, namely the area of planted land in hectares (Ha). With the objective function of achieving maximum profit value from farming results in the three irrigation areas in each planting season (MT), optimal results are obtained in each irrigation area as follows:

1) The November I Planting Season
   a. Paddy planting area in MT I in Sesaot Irrigation Area = 1065,29 Ha
   b. Paddy planting area in MT II in Sesaot Irrigation Area = 532,645 Ha
   c. Secondary crops planting area in MT II in Sesaot Irrigation Area = 532,645 Ha
   d. Secondary crops planting area in MT III in Sesaot Irrigation Area = 1065,29 Ha
   e. Paddy planting area in MT I in Penimbung Irrigation Area = 454 Ha
   f. Paddy planting area in MT II in Penimbung Irrigation Area = 454 Ha
   g. Secondary crops planting area in MT III in Penimbung Irrigation Area = 454 Ha
   h. Paddy planting area in MT I in Ketapang Irrigation Area = 40 Ha
   i. Paddy planting area in MT II in Ketapang Irrigation Area = 40 Ha
   j. Secondary crops planting area in MT III in Ketapang Irrigation Area = 40 Ha
2) The November II Planting Season
   a. Paddy planting area in MT I in Sesaot Irrigation Area = 1065,29 Ha
   b. Paddy planting area in MT II in Sesaot Irrigation Area = 532,645 Ha
   c. Secondary crops planting area in MT II in Sesaot Irrigation Area = 532,645 Ha
   d. Secondary crops planting area in MT III in Sesaot Irrigation Area = 1065,29 Ha
   e. Paddy planting area in MT I in Penimbung Irrigation Area = 454 Ha
   f. Paddy planting area in MT II in Penimbung Irrigation Area = 454 Ha
   g. Secondary crops planting area in MT III in Penimbung Irrigation Area = 454 Ha
   h. Paddy planting area in MT I in Ketapang Irrigation Area = 40 Ha
   i. Paddy planting area in MT II in Ketapang Irrigation Area = 40 Ha
   j. Secondary crops planting area in MT III in Ketapang Irrigation Area = 40 Ha
3) The December I Planting Season
   a. Paddy planting area in MT I in Sesaot Irrigation Area = 949,995 Ha
   b. Paddy planting area in MT II in Sesaot Irrigation Area = 532,645 Ha
   c. Secondary crops planting area in MT II in Sesaot Irrigation Area = 532,645 Ha
   d. Secondary crops planting area in MT III in Sesaot Irrigation Area = 1065,29 Ha
   e. Paddy planting area in MT I in Penimbung Irrigation Area = 454 Ha
   f. Paddy planting area in MT II in Penimbung Irrigation Area = 454 Ha
   g. Secondary crops planting area in MT III in Penimbung Irrigation Area = 454 Ha
   h. Paddy planting area in MT I in Ketapang Irrigation Area = 40 Ha
   i. Paddy planting area in MT II in Ketapang Irrigation Area = 40 Ha
   j. Secondary crops planting area in MT III in Ketapang Irrigation Area = 40 Ha

From the results of running the Solver program regarding the maximum area of planted land that can be irrigated, the profit from the sale of farming business obtained in one year can be calculated and added to the annual benefit value from the results of fulfilling the needs of raw water and electrical energy generated from the utilization of the Meninting Dam.

Table 4. Profit value of farming results

Types of Plants	Profit Value of Farming Results
Paddy	IDR 27.899.540,00
Secondary crops (corn)	IDR 11.080.000,00

Source: BPP West Lombok Regency

Annual Benefit Value for the November I Planting Season

1) Irrigation = ((1065,29 + 532,645 + 454 + 454 + 40 + 40) ha x 27,899,540.00 (IDR/ha)) + (532,645 + 1065,29 + 454 + 40) ha x 11,080 ,000.00 ((IDR/ha))
   = IDR 95,325,038,000.00
2) Raw water = 4,730,400.00 m^3 x 1,500.00 (IDR/m^3)
   = IDR 7,095,600,000.00
3) Electrical energy = 2,032,320.00 kWh x 1,352.00 (IDR/kWh)
   = IDR 2,747,696,600.00

Rounded Total = IDR 105,168,334,600.00

Annual Benefit Value for the November II Planting Season

1) Irrigation = ((1065,29 + 532,645 + 454 + 454 + 40 + 40) ha x 27,899,540.00 (IDR/ha)) + (532,645 + 1065,29 + 454 + 40) ha x 11,080 ,000.00 ((IDR/ha))
   = IDR 95,325,038,000.00
2) Raw water = 4,730,400.00 m^3 x 1,500.00 (IDR/m^3)
   = IDR 7,095,600,000.00
3) Electrical energy = 2,032,320.00 kWh x 1,352.00 (IDR/kWh)
   = IDR 2,747,696,600.00

Rounded Total = IDR 105,168,334,600.00

Annual Benefit Value for the December I Planting Season

1) Irrigation = ((949,995 + 532,645 + 454 + 454 + 40 + 40) ha x 27,899,540.00 (IDR/ha)) + (532,645 + 1065,29 + 454 + 40) ha x 11,080,000 .00 ((IDR/ha))
   = IDR 92,108,346,575.79
2) Raw water = 4,730,400.00 m^3 x 1,500.00 (IDR/m^3)
   = IDR 7,095,600,000.00
3) Electrical energy = 2,032,320.00 kWh x 1,352.00 (IDR/kWh)
   = IDR 2,747,696,600.00

Rounded Total = IDR 101,951,643,200.00

A recapitulation of planting intensity, volume of water requirements, reliability and failure level of the Meninting Dam can be seen in Table 5.

Table 5. Recapitulation of planting intensity, volume of water requirements, reliability and failure of the Meninting Dam

			Planting Season		
			November I	***November II***	***December I***
Planting Intensity	Sesaot Irrigation Area	MT I	100%	100%	89,18%
		MT II	100%	100%	100%
		MT III	100%	100%	100%
		Total Planting Intensity	300%	300%	289,18%
	Penimbung Irrigation Area	MT I	100%	100%	100%
		MT II	100%	100%	100%
		MT III	100%	100%	100%
		Total Planting Intensity	300%	300%	300%
	Ketapang Irrigation Area	MT I	100%	100%	100%
		MT II	100%	100%	100%
		MT III	100%	100%	100%
		Total Planting Intensity	300%	300%	300%
Reliability Level			80,42%	80,42%	80,00%
Failure Level			19,58%	19,58%	20,00%
Volume of Water Requirements	Sesaot Irrigation Area		41,608,915.06 (m^3/year)	42,391,160.42 (m^3/year)	41,856,396.62 (m^3/year)
	Penimbung Irrigation Area		21,974,471.49 (m^3/year)	21,833,809.55 (m^3/year)	21,212,946.35 (m^3/year)
	Ketapang Irrigation Area		2,137,556.36 (m^3/year)	2,042,935.86 (m^3/year)	2,036,488.72 (m^3/year)
Total Volume of Water Requirements			65.720.942,91 (m^3/year)	66.267.905,83 (m^3/year)	65.105.831,69 (m^3/year)

Based on Table 5, the results of optimization for November I and November II planting season respectively show that the water potential in Meninting Dam can reach a maximum planting intensity of 300% for one year. With this planting intensity, the maximum profit from paddy and secondary crops (corn) for one year is IDR 95,325,038,011.15 or rounded up to IDR 95,325,038,000.00, while the profit from paddy and secondary crops (corn) in December I planting season is IDR 92,108,346,575.79 or rounding IDR 92,108,346,600.00. Furthermore, the volume of irrigation water required at each start of planting is different. For the November I planting season, a maximum total volume of irrigation water requirements is 65,720,942.91 m^3/year, for November II planting season, it is 66,267,905.83 m^3/year, and for the December I planting season it is 65,105,831.69 m^3/year. Simulation and optimization results show different reservoir

reliability and failure results. For the November I and November II planting season, the reservoir reliability was 80,42% and the reservoir failure was 19,58%, while for the December I planting season, the reservoir reliability was 80% and the reservoir failure was 20%.

CONCLUSION

The results of the study showed that the optimum intensity, the maximum of profit (IDR) and irrigation area, and the minimum volume of irrigation water requirements per year occurred at the November I planting season, so the November I planting season is recommended for use at the research location. The annual benefit value from the optimization results of the Meninting Dam is the total profit obtained from the prices of irrigation parameters, raw water, and electricity. The amount of annual benefit obtained from the sale of farming business with the results of the November I planting season, raw water, and electricity is IDR 105,168,334,600.00. Future research should focus on sustainable reservoir management strategies, and can also consider the impact of climate change on water availability at the Meninting Dam. Climate change can affect rainfall and temperature patterns, which in turn can affect water availability. In addition, it is also important to collaborate with local governments to ensure that dam construction provides fair benefits to the entire community and reservoir management policies can be better implemented.

REFERENCES

Agastya, D., Yasa, I. W., & Negara, I. D. G. J. (2024). Optimization of Pengga Reservoir in The Mandalika Special Economic Zone for Irrigation and Water Supply. *Journal of the Civil Engineering Forum*, *10*(2), 163–172. https://doi.org/10.22146/jcef.7913

Ajudiya, B. K., Kumar, V., Yadav, S. M., & Solanki, Y. P. (2024). Optimizing performance assessment of multi-reservoir operations for sustainable water management in a semi-arid region. *Water Supply*, *24*(3). https://doi.org/10.2166/ws.2024.040

Arif, C., Purwanto, M. Y. J., Saptomo, S. K., Sutoyo, S., Heryansyah, A., & Sofiyuddin, H. A. (2024). Refining the irrigation water requirement model for paddy field land preparation by empirical data. *BIO Web of Conferences*, *123*, 04011. https://doi.org/10.1051/bioconf/202412304011

Asdak, C., & Salim, H. (2006). Daya Dukung Sumberdaya Air sebagai Pertimbangan Penataan Ruang. *Jurnal Teknologi Lingkungan*, *7*(1).

Bachtiar, S., Limantara, L. M., Sholichin, M., & Soetopo, W. (2023). Optimization of Integrated Reservoir for Supporting the Raw Water Supply. *Civil Engineering Journal (Iran)*, *9*(4). https://doi.org/10.28991/CEJ-2023-09-04-07

Budianto, M. B., Kholilaturrohmi, S., & Setiawan, E. (2022). OPTIMASI PEMANFAATAN SUMBER AIR UNTUK IRIGASI PADA DAERAH ALIRAN SUNGAI KREMIT. *Spektrum Sipil*, *9*(1). https://doi.org/10.29303/spektrum.v9i1.237

Cholik, A., Septyan, R. B., Winata, H., & Nurdiyanto, N. (2025). Analysis of the utilization of Seuseupan Weir water for irrigation in the Seuseupan Irrigation Area (Case study: Seuseupan Weir, Cirebon Regency). *Indonesian Journal of Multidisciplinary Science*, *4*(4), 279–288. https://doi.org/10.55324/ijoms.v4i4.1083

Direktorat Jenderal Sumber Daya Air. (2013). *Standar Perencanaan Irigasi Kriteria Perencanaan Bagian Perencanaan Jaringan Irigasi KP-01*. Kementerian Pekerjaan Umum Direktorat Irigasi dan Rawa.

Irawan, P., Herianto, H., Komala Sari, N., Fauziah, S., Kurnia Hidayat, A., & Gendam Prakoso, W. (2023). OPTIMASI OPERASIONAL BENDUNGAN LEUWIKERIS BERBASIS NILAI MANFAAT. *JURNAL TEKNIK SIPIL CENDEKIA (JTSC)*, *4*(1). https://doi.org/10.51988/jtsc.v4i1.99

Jalaluddin, J., Hartana, H., & Setiawan, E. (2022). Simulation of Water Resources Utilization in the Jereweh Watershed, West Sumbawa Regency, Indonesia. *Path of Science*, *8*(11), 3001–3007. https://doi.org/10.22178/pos.87-4

Kafiansyah, M. Y., Harisuseno, D., & Soetopo, W. (2019). Sustaining Batujai Reservoir Operation Using Simulation and Recursive Optimization. *International Research Journal of Advanced Engineering and Science*, *3*.

McMahon, T., & Mein, R. G. (1978). *Reservoir Capacity and Yield*. Elsevier Science. https://books.google.co.id/books?id=AyXoeMMN8vsC

Mulyawati, I., Salami, I. R. S., Marselina, M., & Sabar, A. (2024). The development of inflow discharge for the karian multipurpose reservoir in the pursuit of reservoir management optimization. *E3S Web of Conferences*, *485*. https://doi.org/10.1051/e3sconf/202448504009

Nait, C., Bisri, M., Soetopo, W., Prayogo, T. B., Krisnayanti, D. S., & Limantara, L. M. (2022). SIMULATION OF THE RAKNAMO RESERVOIR OPERATION BY USING LINEAR PROGRAMMING. *Journal of Southwest Jiaotong University*, *57*(6). https://doi.org/10.35741/issn.0258-2724.57.6.50

Rini, I. (2022). WATER RESOURCES MANAGEMENT TO FULFILL THE BASIC NEEDS OF THE COMMUNITY. *International Journal of Social Science*, *2*(1). https://doi.org/10.53625/ijss.v2i1.2328

Samosir, C. S., Soetopo, W., & Yuliani, E. (2015). Optimasi Pola Operasi Waduk untuk Memenuhi Kebutuhan Energi Pembangkit Listrik Tenaga Air (Studi Kasus Waduk Wonogiri). *Jurnal Teknik Pengairan*, *6*(1).

Setiawan, A. H., Anwar, N., & Margini, N. F. (2017). Optimasi Pola Tanam Menggunakan Program Linier (Waduk Batu Tegi, Das Way Sekampung, Lampung). *Jurnal Hidroteknik*, *2*(1). https://doi.org/10.12962/jh.v2i1.4402

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

Sulistiyono, H., & Lye, L. M. (2010). A spreadsheet based water balance model for the Reak River basin, Lombok, Indonesia. *Proceedings, Annual Conference - Canadian Society for Civil Engineering*, *1*.

Tang, R., Zhang, J., Wang, Y., & Zhang, X. (2024). Study on the Basic Form of Reservoir Operation Rule Curves for Water Supply and Power Generation. *Water (Switzerland)*, *16*(2). https://doi.org/10.3390/w16020276

Triatmodjo, B. (2008). *Hidrologi Terapan*. Beta Offset Yogyakarta.

YASA, I. W., SAADI, Y., SULISTYONO, H., SETIAWAN, E., HARTANA, H., & JAYA NEGARA, I. D. G. (2021). ANALISIS KARAKTERISTIK KEDALAMAN HUJAN DAN IKLIM DI PULAU LOMBOK. *GANEC SWARA*, *15*(2). https://doi.org/10.35327/gara.v15i2.219

Zabadi, F. (2023). OPTIMIZATION OF WATER RESOURCES UTILIZATION DISTRIBUTION FOR AGRICULTURAL BENEFITS IN THE CLAMPIS IRRIGATION AREA SAMPANG DISTRICT. *Journal Innovation of Civil Engineering (JICE)*, *4*(1). https://doi.org/10.33474/jice.v4i1.19572