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Feasibility Study Development Of Randugunting Dam By Taking Larap Factor (Land Aquisition and Resettlement Action Plan)

Muji Rifai, Pratikso, Soedarsono
Sultan Agung Islamic University, Department of Civil Engineering
Jl. Raya Kaligawe Km.04, Semarang, Jawa
rifaimuji@gmail.com

Abstract- Water is an essential ingredient for food availability, health and survival. Dams is one form of building in an effort to conserve water resources. The Randugunting Dam Development Plan in Blora Regency enters into 65 priority Dam in NAWACITA. Then to determine a project is feasible to be implemented or not, feasibility studies should be undertaken so that the business or project that is run not be in vain in the future.

Any proposed public or private program or activity that is beneficial to the public interest and will result in an impact on 200 or more persons and requires compensation, it should be supplemented with a Land Acquisition and Resttlement Action Plan (LARAP) the policy covers: 1) Land acquisition and / resettlement should be avoided or minimized as far as possible; 2) If procurement of land is inevitable, the compensation provided and the transfer of the PAP should be accompanied by coaching efforts; 3) WTD receives appropriate compensation based on calculated replacement cost of affected assets; 4) In determining the amount of compensation value should be based on consultation and discussion with WTD.

The cost components of the Randugunting Dam Development include pre-construction costs (land planning and acquisition / LARAP), construction costs and maintenance operation costs. Benefit components are viewed from the parties concerned with the project, especially for people in need including agriculture, fisheries, raw water, flood control, electricity and tourism.

Development cost of Randugunting Dam with investment of Rp. 861.714.687.361 for 50 years. In view of the calculation results, NPV can be concluded of 139.866.838.506> 0 then the NPV is acceptable. The rate of return with the interest rate of 11.63% then the value of IRR of 11.63%> of DF = 10.49% so that investment is feasible. With the age of 50 years reservoir with the value of BCR of 1.16> 1 then the dam construction is feasible. BEP (Break Even Point) of the analysis produces BEP in the 30.4 year.

***Keywords*:** Feasibility Study, LARAP, Dams

1. Introduction

Dams Randugunting planned to be built in the Village Kalinanas, District Japah, Blora District. The dam project is planned to be built by the Government through the Ministry of Public Works and People's Housing. Where the cost for dam construction includes land acquisition (LARAP) of Rp. 308,440,857,475, - and the construction of Rp. 437.383.000.000, so that if this is the cost of Randugunting Dam construction costs reached Rp. 745.823857.475, -.

The benefit of this Randugunting Dam is to serve the water needs of the development of irrigation area of 630 ha and the fulfillment of 80,131 people's water needs. The Randugunting Reservoir has a storage volume of 10.4 million m3 with an effective storage volume of 8.61 million m3. With the construction of dams, the conto is expected to overcome the water problem in the Irrigation Area of Kedungsapen and the fulfillment of clean water needs for the community in Blora and Kab regency. Rembang.

2. Literature Review

2.1 Benefit Cost Ratio (BCR)

Benefit cost ratio is one of the most frequently used methods in the early evaluation stages of investment planning or as an additional analysis in order to validate the results of evaluations that have been done with other methods. The BCR method emphasizes the value of the comparison between the benefit aspect (benefit) that will be obtained with the cost and loss aspect (cost) with the investment (Giatman, 2007). Benefit and cost comparison are parameters for economic analysis, to see if the project is profitable or not. In general the formula of comparison between benefits and costs is (Giatman, 2007):

$$\text{BCR} = \frac{PV\ Benefit}{PV\ Cost}$$

If the price of B / C is more than 1, then the project is feasible. Otherwise the project is not feasible if the B / C is less than 1.

2.2 Net Present Value (NPV)

NPV is the difference between the benefits with costs that have been in present value kan. This criterion says that the project will be selected if NPV> 0. Thus, if a project has NPV <0, it is not feasible to run. The NPV value can be searched using equations (Kadariah 1988: 40):
Difference in Costs and Benefits = Current Value of Benefit - The Current Value of the Cost.

2.3 Internal Rate of Return (IRR)

The Internal Rate of Return is the interest rate that makes benefits and costs equal to BC = 0 or the interest rate that makes B / C = 1. If the annual fees and annual benefits of the IRR calculation can be done on an annual basis , but if not constant can be done on a trial and error basis. IRR calculation is done by finding the value of the discount rate so that the present value of benefits is equal to the present value of value, or the value of NPV = 0. If the discount rate is greater than the IRR value, then the project is profitable, but if the discount rate is equal to the value IRR then the project is said to break even.

2.4 Break Even Point (BEP)

Break Even Point (BEP) is a break-even point where the costs incurred and income are balanced (NPV = 0), so at that time the investment does not suffer losses or profits.

3. Research Methods

Analysis of investment in the field of dam construction is by measuring the value of cost and benefit value. There are various ways to measure the value of costs and benefits. In this study will use the criteria of investment feasibility level using the formula NPV, BCR, IRR, BEP and Analia sensitivity as parameters in determining the policy to be taken. The calculation of investment cost in this study is calculated by approximate estimation method. Research begins with the activities of collecting data from various sources related to the issues raised. The data obtained are summarized and placed in accordance with the needs so as to describe the position or circumstances required. Furthermore, the data is analyzed systematically by using formulations in technical economics.

4. Result And Discussion

This study examines the economic feasibility of the Randugunting Dam development in Blora Regency so that it will be known whether the dam construction is feasible to build or not, then produce a recommendation as a guide to take further steps in the effort to build the dam.

4.1 Age Usage For Dam

The age for the reservoirs of the plan is determined in order to know the ratio of the cost of how many years old, so that the reservoir is feasible to build. Determination of the age of the dam building is done by calculating how long the dead storage capacity is filled by the sediment rate each year. Where to collect die capacity can be seen in Appendix 1 Technical Data of Randugunting Dam which is volume of capacity of planned sediment of 1,79 million m3, while for annual sediment rate can be seen in Appendix 2 Volume of Sedimentation of Randugunting Dam from average of sediment volume per year of 35,897 m3 per year.

Then can be done as follows :

$$T = \frac{V}{Lj}$$

Where :

T = Age plan for reservoir (year)

V = Dead reservoir (m3)

Lj = Sedimentation rate (m3 / year)

So :

$$T = \frac{1.790.000}{35.897}$$

$$= 49{,}86 \approx \text{years}$$

It is known that the age of the Randugunting Dam from the calculation is for 50 years.

4.2 Discount Factor (DF)

To know the present value of cost and benefit, please first know the discount rate (DF), by using the following formula :

$$\textit{Discount Rate}\ (\text{DF}) = \frac{1}{(1+i)^n}$$

Where :

i = interest rate

n = year

4.3 Cost

Randugunting Dam Development project, the cost is divided into 4 sections, namely Planning Cost, Land Acquisition Cost, Construction Cost and Operational Cost and Maintenance.

A. Land Aquisition Cost (LARAP)

The land requirement for Randugunting Dam is 241,428 ha (construction of weir, wide pool of puddle and greenbelt). Total land that must be exempted 226,028 ha with details according to the following table.

Table 1. Land Requirement Development of Randugunting Dam

No	Bagian Bendungan	Peruntukan	Status Lahan	Desa	Luas (Ha)
1.	Tapak Bendungan	Konstruksi Bendungan	Perhutani	Desa Kalinanas	9,3620
2.	Genangan dan Greenbelt	Genangan dan greenbelt	- Perhutani	Desa Kalinanas	109,649
				Desa Gaplokan	73,100
				TOTAL	**182,749**
			- Masyarakat	Desa Kalinanas	10,079
				Kalinanas/ Gaplokan*	5,668
				Desa Gaplokan	16,655
				TOTAL	**32,402**
		Jalan akses kabupaten	Bina Marga Kabupaten Blora	Desa Gaplokan	0,317
		Jalan DK	BUMN	Desa Kalinanas dan Desa Gaplokan	1,198
		Sungai	-	-	15,400
JUMLAH					**241,428**

Source: Field Inventory Result PT. Caturbina Guna Persada Year 2016 and processed

Table 2 Types of Vegetation Existing on the Plan of Randugunting Dam Area

No	Status lahan	Desa	Luas (Ha)	Jenis Pemanfaatan Lahan	Vegetasi	Jumlah Tegakkan
1	Perhutani	Kalinanas dan Gaplokan	109,649	Kebun	Jati	91.375
			73,100	Kebun	Mahoni	81.222
			9,362	Rimba		
2	Masyarakat	Kalinanas	10,079	Ladang	Jagung	772
		Kalinanas dan Gaplokan	5,668	Ladang	Jagung	131
		Gaplokan	16,655	Kebun	Nangka	58
				Ladang	Bambu	710
					Singkong	345
					Pisang	45

Source: Field Inventory Result PT. Caturbina Guna Persada Year 2016 and processed

Table 3. Land Acquisition Cost of Randugunting Dam

No	Item	Volume (Ha)	Volume Tegakkan (batang)	Jumlah Harga NJOP (Rp.)	Jumlah Harga Pasaran (Rp.)	Jumlah Harga Harapan (Rp.)
1	*2*	*3*	*3*	*4*	*5*	*6*
A.	***LAHAN WARGA***					
1	Desa Kalinanas	10,079 Ha		Rp 477.052.575	Rp 4.770.525.749	Rp 29.661.258.460
2	Desa Kalinanas / Gaplokan	5,668 Ha		Rp 251.980.443	Rp 2.519.804.427	Rp 15.388.511.935
3	Desa Gaplokan	16,655 Ha	58 pohon	Rp 1.084.413.307	Rp 10.234.383.097	Rp 44.813.994.196
	Sub Total A	**32,402 Ha**		**Rp 1.813.446.325**	**Rp 17.524.713.274**	**Rp 89.863.764.591**
B.	***LAHAN PERHUTANI***					
1	Tanaman Jati	105,939 Ha	91.375 pohon		Rp 236.166.375.401	
2	Tanaman Mahoni	80,899 Ha	81.222 pohon		Rp 56.692.744.141	
3	Tanaman Rimba	9,362 Ha	-		Rp -	
	Sub Total B	**192,616 Ha**			**Rp 292.859.199.542**	
C.	***Bina Marga Kabupaten Blora***					
1	Jalan Kabupaten	0,317 Ha		PENGGANTIAN DENGAN TRASE JALAN ATAU JEMBATAN		
	Sub Total C	**0,317 Ha**				
D.	***Kementerian BUMN***					
1	Jalan DK	1,198 Ha		PENGGANTIAN DENGAN TRASE JALAN		
	Sub Total D	**1,198 Ha**				
	TOTAL (A+B+C)			**Rp 294.672.565.891**	**Rp 310.383.832.816**	**Rp 382.722.884.133**

Source: Field Inventory Result PT. Caturbina Guna Persada Year 2016 and processed

B. Construction Cost

The cost of construction is the result of the multiplication of the work volume of each work item and the unit price of the work. The total cost of Randugunting Dam construction in Blora Regency is as follows.

Table 4 Construction Cost of Randugunting Dam

NO	JENIS PEKERJAAN	JUMLAH HARGA Rp
I	PEKERJAAN PERSIAPAN	6,921,386,396.00
II	PEKERJAAN COFFERDAM	9,520,984,426.00
III	PEKERJAAN BENDUNGAN UTAMA	204,923,672,630.88
IV	PEKERJAAN PELIMPAH/SPILLWAY	91,002,159,062.72
V	PEKERJAAN M & E	44,558,046,140.15
VI	PEKERJAAN INSTRUMENTASI PENGUKURAN DAN METEOROLOGI	6,778,580,954.00
VII	PEKERJAAN BANGUNAN FASILITAS	28,471,993,897.91
VIII	PEK. LANSEKAP, STABILITAS LERENG RAWAN LONGSOR DAN PEMBERSIHAN GENANGAN	5,443,999,750.00
	JUMLAH	397,620,823,257.66
	PPN 10 %	39,762,082,325.77
	TOTAL	437,382,905,583.43
	DIBULATKAN	437,382,000,000.00
TERBILANG :	Empat Ratus Tiga Puluh Tujuh Milyar Tiga Ratus Delapan Puluh Dua Juta Rupiah	

Source: Field Inventory Result PT. Caturbina Guna Persada Year 2016 and processed

C. Indirect Cost

ndirect costs are the pre-investment that is the initial stage of a development project. In this stage the activities are carried out such as socialization, feasibility study, detail design, UKL / UPL or AMDAL study, and administration / permit administration. Indirect costs calculated include :

Consulting services (A) = 2,0 % x construction cost
= 2,0 % x Rp. 437.382.000.000,-
= Rp.8.747.640.000,-
Administration cost (B) = 1,5 % x construction cost
= 1,5 % x Rp. 437.382.000.000,-
= Rp. 6.560.730.000,-
Unforeseen expenses (C) = 1 % x construction cost
= 1 % x Rp. 437.382.000.000,-
= Rp. 4.373.820.000,-
Indirect cost = A + B + C
= Rp. 19.682.190.000,-

D. Operating and Maintenance Cost

Dam operation and maintenance costs are all costs incurred to finance dam activities in order to optimize the function and benefits of the dam and its infrastructure premises in accordance with the planned service age and maintain its security.

In this study, to calculate the operating and maintenance costs of dams using empirical methods. This method is done by specifying a certain percentage (%) of the acquisition of the asset value at the time of construction. Based on the results of the study (Regulation of the Minister of Public Works No. 8 of 2014 on Guidelines for Costing of Water Resources Management for Water Business Operations, Industrial Business Activities, Water Power Business Operations, and Agricultural Business Activities, 2014), the percentage used to calculate operating and maintenance costs are as follows :

Operation cost	0,9 % construction cost
Maintenance cost	0,60 % construction cost (Age Usage < 5 years)
	1,30 % construction cost (Age Usage 5-25 years)
	1,90 % construction cost (Age Usage >25 years)
Aset Value	= Construction Cost
Aset Value	= Rp. 437.382.000.000,-
Operation factor	= 0,90 %
Maintenance factor	= 1,90 %
OP factor	= 2,80 %
OP cost	= 2,80 % x aset value
	= 2,80 % x Rp. 437.382.000.000,-
	= Rp 12.246.696.000,- / year
PV Biaya OP	**= Rp.94.266.664.545**

4.4 Benefit

Benefits to be gained from the following sectors:

A. Agriculture

Economic Benefit Value (NME) for smallholder agriculture is derived from the calculation of agricultural profits (total revenue minus total cost of production)

Total Production Cost = Rp. 12.000.000,- / ha
Harvest Area = agricultural land area x indices of planting
= 630 ha x 2
= 1.260 ha
Number of Harvest = Harvest Area x productivity of paddy fields
= 1.260 ha x 6 ton/ha
= 7.560 ton
Receipts = number of harvest x selling price of grain

= 7.560 ton x Rp. 4.200
= Rp. 31.752.000.000,-

Total Production Cost = area of agricultural land x unit cost of production
= 630 x Rp. 12.000.000,-
= Rp. 7.560.000.000,-

Economic Benefit Value= farmer acceptance - total cost of production
= Rp. 31.752.000.000 – Rp. 7.560.000.000
= Rp. 24.192.000.000,-

PV Agricultural Benefits = Rp. 307.531.764.404

B. Fishery

Fishery pattern that will be applied in Randugunting Dam is keramba system, so it will be determined how wide of part of reservoir that can be used for fishery of Floating Net Cage (KJA)

Area of KJA	= 9 ha
Production of KJA Waduk	= 134,570 kg / year (Blora 2016 BPS) (with an area of KJA 79 ha)
Productivity	= 134.570 / 79 = 1.703 kg / ha
Production of KJA Randugunting	= 9 ha x 1,703 kg / ha = 15,327 kg
Average price of fish commodities	= Rp. 28.000 / kg
NME Fishery	= 15,327 x Rp. 28,000 = Rp. 429.156.000, - / year
PV Fishery Benefits	= Rp. 5.267.082.051

C. Drinking Water

Economic Benefit Value for drinking water business on Randugunting Dam as follows :

Water rate	= Rp. 3.900,- / m3	(BPS Kab.Blora Tahun 2016)
Water rate	= Rp. 3.500,- / m3	(BPS Kab.Rembang Tahun 2016)

Prior to the operation of Randugunting Dam, the service plan area contained only 1,380 people using PDAM (Sumber and Bulu), while Kec. Japah has not connected PDAM. After the operation of the dam, the plan to be served water through PDAM is 80,131 inhabitants.

Before operation	= 1,380 people (BPS Rembang, Year 2016)
Revenue	= Rp. 134,042,850, - / year (BPS Rembang, Year 2016)
Water volume	= 0.1 m3 / sec (DED Report 2015) = 0.1 x 24 x 60 x 60 x 365 = 3.153.600 m3 / year
Water loss	= 25% (maximum standard of PDAM)
Average water rate	= Rp. 3,700, - / m3
NME Drinking Water	= Water rate x water volume x (1 - percent water loss) = Rp. 3.700 x 3.153.600 x (1 - 0.25) = Rp. 8.751.240.000, - / year
PV Drinking Water	= Rp. 73.491.066.967

D. Flood Control

For the value of benefits in terms of flood control is by calculating the amount of rice fields that are secured from regular flooding due to the construction of Randugunting

Dam (in hectares)

Resettable land	= harvested area of irrigation development area
	= 630 ha
NME Flood Control	= rescued lands x farming NME
`	= 630 ha x Rp. 19.200.000 / ha
	= Rp. 24.192.000.000, - / year
PV Flood Control	= Rp. 307.531.764.404

E. Tourism

The revenue component is derived from the sale of tour package products and rental of premises. In the sales component of the tour package is included in the form of ticket sales, income from tourism facilities and food / beverage sales. So the value of economic benefits of the tourism sector are as follows.

Entrance fee	= Rp. 5,000, - / person (assumption)
Tours and meals	= Rp. 20.000, - / person (assumption)
Number of tourists	= 90,402 persons / year / 2 reservoir location (BPS 2016)
	(so each estimated reservoir location 45,201 person / year)
NME Tourism	= 45,201 x (5,000 + 20,000)
	= Rp. 1.130.025.000, - / year
PV Tourism	= Rp. 9.947.460.348

F. Minihidro Power Plant

The revenue component is obtained from the sale of electricity to the state electricity company (PLN). In this calculation, the electrical capacity to be managed is less than 10 mW, so the power plant is minihidro (MHP). The value of economic benefits from the electricity sector is as follows.

Number of turbines available	= 3 pieces (assumption)
Turbine capacity	= 2 mW
Average electricity production	= 60,000,000 kWH / year
Rate	= Rp. 582 / kwH (PLN Blora)
NME Electric	= 60,000,000 x 582
	= Rp. 34.920.000.000, - / year
PV Electric	= Rp. 297.812.387.694

The total benefits of the Randugunting Dam represent the value of benefits that have been presented from the dam to the age of the plan.

Total = PV Agriculture + PV Fishery + PV Water Supply + PV Flood Control + PV Tourism + PV Minihidro Power Plant

= Rp. 307.531.764.404 + Rp. 5.267.082.051 + Rp. 73.491.066.967 + Rp. 307.531.764.404 + Rp. 9.947.460.348 + 297.812.387.694

= Rp. 1.001.581.525.868,-

4.5 Project Feasibility Assessment

The project feasibility assessment is calculated by comparing the costs incurred and the benefits generated from a project. So it can give a picture of whether the project to be built later worth doing or not.

A. Benefit Cost Ratio (BCR)

In calculating the cost benefit ratio (BCR) in this thesis, the present value of benefits and costs are calculated. Benefit value represents the total value of the increase of all benefits after the operation of the reservoir over the next 50 years that has been

presented. As for the value of Cost is a combination of the value of initial investment costs (Planning + LARAP), construction, as well as operational and maintenance costs (O + M) for the run of reservoirs over the next 50 years that have been presented. The calculation is, as follows :

Cost → Indirect Cost + LARAP + Construction Cost + Present Cost Total OP
Total Cost = Rp. 861.714.687.361, -
Benefit Value → NME Present Agriculture + NME Present Total Fisheries + NME Present Total Drinking Water + NME Present Total Flood Control + NME Present Total Tourism
Total Benefits = Rp. 1,001,581,525,868, -
BCR = Benefit / Cost
= (Rp.1.001.581.525.868) / (Rp.861.714.687.361)
= 1.16> 1

From the results mentioned above can be BCR greater than one, then Randugunting Dam is feasible to build.

B. Net Present Value (NPV)

This feasibility appraisal method uses the difference between benefits and costs calculated on the present value. If the benefit is greater than the cost it is considered feasible (NPV> 0), but otherwise if benefits are less than the cost is considered unfeasible (NPV <0). In the previous analysis has calculated the present value of each component cost or benefit with the interest rate (i) which has been determined that is 10.49%. Then the NPV calculation as follows:

Benefit (B) = Rp. 1,001,581,525,868, -
Cost (C) = Rp. 861.714.687.361, -
B - C = Rp. 139.866.838.506, -
NPV > 0, the project is feasible to implement

From the above results can be B - C positive value which means the benefits received is greater than the costs incurred, the Dam Randugunting feasible to build.

C. Internal Rate of Return (IRR)

That is the interest rate that makes the benefits and costs have the same value or B - C = 0 or the interest rate that makes B / C = 1. Since the annual costs and benefits are not constant, it is done on the basis of present value, and sought by trial and error.

Table 5 Determination of IRR By Trial

Tahun ke-	Tahun	*i = 10,49 %*			*i = 12,00 %*		
		PV BIAYA	**PV MANFAAT**	**NPV= B-C**	**PV BIAYA**	**PV MANFAAT**	**NPV = B-C**
		(Rp)	**(Rp)**	**(Rp)**	**(Rp)**	**(Rp)**	**(Rp)**
0	2015	19.682.190.000		(19.682.190.000)	19.682.190.000		(19.682.190.000)
1	2016	310.383.832.816		(310.383.832.816)	310.383.832.816		(310.383.832.816)
2	2017	218.691.000.000		(218.691.000.000)	218.691.000.000		(218.691.000.000)
3	2018	218.691.000.000		(218.691.000.000)	218.691.000.000		(218.691.000.000)
4	2019	8.217.260.276	62.723.251.886	54.505.991.609	7.782.996.709	59.408.470.290	51.625.473.582
5	2020	7.511.478.757	58.853.628.926	51.342.150.169	7.018.595.246	54.991.808.345	47.973.213.098
6	2021	6.866.316.902	55.252.482.464	48.386.165.562	6.329.268.927	50.930.917.611	44.601.648.684
7	2022	6.276.568.079	51.884.294.730	45.607.726.651	5.707.644.301	47.181.372.904	41.473.728.604
8	2023	5.737.472.857	48.733.245.334	42.995.772.477	5.147.072.093	43.718.468.613	38.571.396.521
9	2024	5.244.680.592	45.784.630.484	40.539.949.892	4.641.556.083	40.519.518.096	35.877.962.013
10	2025	4.794.214.316	43.024.781.917	38.230.567.600	4.185.688.968	37.563.684.715	33.377.995.747
11	2026	4.382.438.645	40.440.991.824	36.058.553.179	3.774.594.516	34.831.827.279	31.057.232.763
12	2027	4.006.030.439	38.021.443.338	34.015.412.899	3.403.875.412	32.306.358.644	28.902.483.232
13	2028	3.661.951.980	35.755.146.147	32.093.194.167	3.069.566.219	29.971.116.326	26.901.550.107
14	2029	3.347.426.464	33.631.876.870	30.284.450.406	2.768.090.966	27.811.244.108	25.043.153.142
15	2030	3.059.915.584	31.642.123.822	28.582.208.238	2.496.224.889	25.813.083.678	23.316.858.789
16	2031	2.797.099.050	29.777.035.846	26.979.936.797	2.251.059.944	23.964.075.446	21.713.015.502
17	2032	2.556.855.860	28.028.374.918	25.471.519.058	2.029.973.700	22.252.667.745	20.222.694.045
18	2033	2.337.247.189	26.388.472.220	24.051.225.031	1.830.601.283	20.668.233.693	18.837.632.411
19	2034	2.136.500.734	24.850.187.444	22.713.686.710	1.650.810.085	19.200.995.071	17.550.184.985
20	2035	1.952.996.417	23.406.871.079	21.453.874.662	1.488.676.952	17.841.952.598	16.353.275.646
21	2036	1.785.253.309	22.052.329.452	20.267.076.143	1.342.467.609	16.582.822.075	15.240.354.467
22	2037	1.631.917.678	20.780.792.326	19.148.874.648	1.210.618.111	15.415.975.879	14.205.357.768
23	2038	1.491.752.063	19.586.882.866	18.095.130.803	1.091.718.118	14.334.389.362	13.242.671.244
24	2039	1.363.625.291	18.465.589.786	17.101.964.495	984.495.803	13.331.591.727	12.347.095.924
25	2040	1.246.503.343	17.412.241.531	16.165.738.188	887.804.251	12.401.621.012	11.513.816.761
26	2041	1.139.441.014	16.422.482.328	15.283.041.314	800.609.191	11.538.982.819	10.738.373.629
27	2042	1.041.574.282	15.492.249.979	14.450.675.697	721.977.931	10.738.612.480	10.016.634.550
28	2043	952.113.336	14.617.755.258	13.665.641.922	651.069.384	9.995.840.362	9.344.770.978
29	2044	870.336.202	13.795.462.801	12.925.126.600	587.125.070	9.306.360.049	8.719.234.979
30	2045	795.582.916	13.022.073.375	12.226.490.459	529.461.000	8.666.199.156	8.136.738.156
31	2046	727.250.199	12.294.507.423	11.567.257.224	477.460.366	8.071.692.554	7.594.232.188
32	2047	664.786.588	11.609.889.795	10.945.103.207	430.566.937	7.519.457.798	7.088.890.860
33	2048	607.687.984	10.965.535.575	10.357.847.591	388.279.113	7.006.372.578	6.618.093.464
34	2049	555.493.587	10.358.936.923	9.803.443.336	350.144.557	6.529.554.022	6.179.409.465
35	2050	507.782.173	9.787.750.859	9.279.968.686	315.755.360	6.086.339.694	5.770.584.334
36	2051	464.168.698	9.249.787.918	8.785.619.220	284.743.673	5.674.270.140	5.389.526.467
37	2052	424.301.190	8.743.001.620	8.318.700.429	256.777.776	5.291.072.864	5.034.295.088
38	2053	387.857.908	8.265.478.677	7.877.620.769	231.558.530	4.934.647.606	4.703.089.076
39	2054	354.544.743	7.815.429.910	7.460.885.166	208.816.175	4.603.052.814	4.394.236.639
40	2055	324.092.851	7.391.181.795	7.067.088.944	188.307.443	4.294.493.212	4.106.185.768
41	2056	296.256.475	6.991.168.619	6.694.912.144	169.812.962	4.007.308.375	3.837.495.413
42	2057	270.810.969	6.613.925.182	6.343.114.213	153.134.903	3.739.962.225	3.586.827.322
43	2058	247.550.981	6.258.080.012	6.010.529.031	138.094.868	3.491.033.372	3.352.938.503
44	2059	226.288.796	5.922.349.065	5.696.060.269	124.531.979	3.259.206.224	3.134.674.245
45	2060	206.852.823	5.605.529.855	5.398.677.032	112.301.160	3.043.262.823	2.930.961.663
46	2061	189.086.208	5.306.496.004	5.117.409.796	101.271.582	2.842.075.319	2.740.803.737
47	2062	172.845.570	5.024.192.166	4.851.346.596	91.325.266	2.654.599.049	2.563.273.783
48	2063	157.999.842	4.757.629.307	4.599.629.465	82.355.820	2.479.866.171	2.397.510.351
49	2064	144.429.216	4.505.880.313	4.361.451.098	74.267.302	2.316.979.792	2.242.712.490
50	2065	132.024.172	4.268.075.900	4.136.051.728	66.973.192	2.165.108.571	2.098.135.379
		861.714.687.361	**1.001.581.525.868**	**139.866.838.506**	**846.078.144.542**	**801.298.545.287**	**(44.779.599.256)**

Sumber : Hasil Analisis, Tahun 2017

IRR can also be interpreted where the value of NPV = 0. From the table above, can be calculated the value of IRR by interpolating the NVP and interest rates in order to obtain the value of NPV 0 at a certain interest rate. So the calculation is as follows :

$$\text{IRR} = i' + \frac{NPV'}{(NPV' - NPV'')} \times (i'' - i')$$

$$= 10{,}49 + \frac{(139.866.838.506)}{(139.866.838.506 - (-44.779.599.256))} \times (12 - 10{,}49)$$

$$= 11{,}63\ \%$$

DF = 10,49 %

IRR > DF (discount rate), so the project is feasible.

D. Break Even Point

Break Even Point (BEP) is a break-even point where the costs incurred and income are balanced (NPV = 0), so at that time the investment does not suffer losses or profits.

Table 6 Comparison of Benefits and Costs

Tahun ke-	Tahun	Investasi / Modal	Pendapatan/ Tahun	Pengeluaran/Tahun (OP)	B = C
			(Rp)	(Rp)	(Rp)
0	2016	191.862.005.704			(191.862.005.704)
1	2017	191.862.005.704			(383.724.011.408)
2	2018	191.862.005.704			(575.586.017.112)
3	2019	191.862.005.704			(767.448.022.816)
4	2020		62.723.251.886	8.217.260.276	(712.942.031.207)
5	2021		58.853.628.926	7.511.478.757	(661.599.881.038)
6	2022		55.252.482.464	6.866.316.902	(613.213.715.475)
7	2023		51.884.294.730	6.276.568.079	(567.605.988.824)
8	2024		48.733.245.334	5.737.472.857	(524.610.216.348)
9	2025		45.784.630.484	5.244.680.592	(484.070.266.456)
10	2026		43.024.781.917	4.794.214.316	(445.839.698.855)
11	2027		40.440.991.824	4.382.438.645	(409.781.145.676)
12	2028		38.021.443.338	4.006.030.439	(375.765.732.777)
13	2029		35.755.146.147	3.661.951.980	(343.672.538.610)
14	2030		33.631.876.870	3.347.426.464	(313.388.088.204)
15	2031		31.642.123.822	3.059.915.584	(284.805.879.966)
16	2032		29.777.035.846	2.797.099.050	(257.825.943.170)
17	2033		28.028.374.918	2.556.855.860	(232.354.424.112)
18	2034		26.388.472.220	2.337.247.189	(208.303.199.081)
19	2035		24.850.187.444	2.136.500.734	(185.589.512.371)
20	2036		23.406.871.079	1.952.996.417	(164.135.637.709)
21	2037		22.052.329.452	1.785.253.309	(143.868.561.566)
22	2038		20.780.792.326	1.631.917.678	(124.719.686.917)
23	2039		19.586.882.866	1.491.752.063	(106.624.556.115)
24	2040		18.465.589.786	1.363.625.291	(89.522.591.620)
25	2041		17.412.241.531	1.246.503.343	(73.356.853.432)
26	2042		16.422.482.328	1.139.441.014	(58.073.812.118)
27	2043		15.492.249.979	1.041.574.282	(43.623.136.421)
28	2044		14.617.755.258	952.113.336	(29.957.494.498)
29	2045		13.795.462.801	870.336.202	(17.032.367.899)
30	2046		13.022.073.375	795.582.916	(4.805.877.439)
30,4					0
31	2047		12.294.507.423	727.250.199	6.761.379.784
32	2048		11.609.889.795	664.786.588	17.706.482.991
33	2049		10.965.535.575	607.687.984	28.064.330.582
34	2050		10.358.936.923	555.493.587	37.867.773.919
35	2051		9.787.750.859	507.782.173	47.147.742.605
36	2052		9.249.787.918	464.168.698	55.933.361.825
37	2053		8.743.001.620	424.301.190	64.252.062.254
38	2054		8.265.478.677	387.857.908	72.129.683.024
39	2055		7.815.429.910	354.544.743	79.590.568.190
40	2056		7.391.181.795	324.092.851	86.657.657.134
41	2057		6.991.168.619	296.256.475	93.352.569.279
42	2058		6.613.925.182	270.810.969	99.695.683.491
43	2059		6.258.080.012	247.550.981	105.706.212.523
44	2060		5.922.349.065	226.288.796	111.402.272.791
45	2061		5.605.529.855	206.852.823	116.800.949.824
46	2062		5.306.496.004	189.086.208	121.918.359.619
47	2063		5.024.192.166	172.845.570	126.769.706.215
48	2064		4.757.629.307	157.999.842	131.369.335.681
49	2065		4.505.880.313	144.429.216	135.730.786.778
50	2066		4.268.075.900	132.024.172	139.866.838.506

Sumber : Hasil Analisis, Tahun 2017

From the table above can be known break-even point (BEP) Randugunting Dam Development occurred in the year to 30.4. So in that year the value of expenditure = the value of income.

5. Conclusion

From the results of calculations that have been done then the conclusion of the results of the calculations that have been done as follows :

a) Development cost of Randugunting Dam with investment of Rp. 861.714.687.361 for 50 years.
b) From the results of NPV calculation, NPV can be summed up to 139.866.838.506> 0 then NPV is acceptable.
c) Rate of return with interest rate of 11.63% then the value of IRR of 11.63% > of DF = 10.49% so that investment is feasible.
d) With age of 50 year reservoir with value of BCR equal to 1.16> 1 then the dam construction is feasible to be implemented
e) Break Even Point (BEP) of the analysis produces BEP in the 30.4 year

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