Financial and Economic Analysis Irrigation Area Development Bajayu – Serdang Bedagai

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Abstract
Serdang Bedagai is one of the rice granaries in North Sumatera Province, but its agricultural potential has not been well managed due to lack of water for irrigation, especially in the dry season. With bajayu weir construction, is expected to improve water demand forclean water and irrigation for agricultural processes can be developed and managed bygood. The cost of construction of the dam construction is very large, so it needs to be reviewed if the benefits and income generated are proportional to the costs and losses incurred. The final goal of this research is to conduct financial and economic analysis in the construction of bajayu weir. This study uses financial and economic analysis using Net Present Value (NPV), Internal Rate of Return (IRR), Benefit cost Ratio (BCR) indicators and also analyzes sensitivity due to cost changes. Optimal handling is estimated after 10 years, so within that time the benefit increases linearly until the 13th year and will remain from year 13 to the next. From the calculation of finance development of bajau irrigation area obtained NPV = Rp.1.778.603.070.507,62-, IRR = 27%, BCR = 4.6. And from the economic calculation of the area of irrigation bajayu obtained NPV = Rp.1.235.038.404.979,95-, IRR = 32% BCR = 6.92. And calculation of sensitivity analysis has also been done to change of cost and benefit equal to ± 5% and ± 10% for financial and economic analysis indicate that project plan still very feasible.

Key words: Feasibility analysis of investment, NPV, IRR, BCR, North Sumatra.

Abstrak
Serdang Bedagai merupakan salah satu lumbung padi di Provinsi Sumatera Utara, Namun Potensi pertaniannya belum dikelola dengan baik karena kekurangan air untuk pengairan, terutama pada musim kering. Dengan pembangunan Bendung bajayu, diharapkan bisa memperbaiki kebutuhan air untuk air bersih dan irigasi untuk proses pertanian dapat dikembangkan dan dikelola dengan baik. Biaya konstruksi pembangunan bendung sangat besar, sehingga perlu ditinjau ulang jika manfaat dan pendapatan yang dihasilkan sebanding dengan biaya dan kerugian yang terjadi. Tujuan akhir dari penelitian ini adalah untuk melakukan analisis finansial dan ekonomi di pembangunan bendung bajayu. Penelitian ini menggunakan analisis finansial dan ekonomi dengan menggunakan indikator Net Present Value (NPV) , Internal Rate of Return (IRR), Benefit cost Rasio (BCR) dan juga mengetahui analisa sensitivitas akibat perubahan biaya. Penanganan Secara Optimal diperkirakan sesudah 10 tahun, sehingga dalam jangka waktu tersebut benefit meningkat secara linear sampai tahun ke-13 dan akan tetap dari tahun ke-13 sampai tahun berikutnya. Dari hasil perhitungan finansial pembangunan daerah irigasi bajau didapat NPV = Rp.1.778.603.070.507,62-, IRR= 27%, BCR = 4,6. Dan dari hasil perhitungan ekonomi daerah irigasi bajayu didapat NPV= Rp. 1.235.038.404.979,95-, IRR=32% BCR=6,92. Dan perhitungan analisis sensitivitas juga telah dilakukan terhadap perubahan biaya dan benefit sebesar ± 5% dan ± 10% untuk analisa finansial dan ekonomi menunjukkan bahwa rencana proyek masih sangat layak.

Key words : Feasibility analysis of investment, NPV, IRR, BCR, Sumatera Utara.

1. Introduction

Serdang Bedagai Regency is one of barn rice in the province of North Sumatra. To maintain and increase the productivity of agricultural land in the area requires adequate irrigation water. Agricultural production is certainly very influenced by the availability of water supply, especially at

this time across the paddy fields in Serdang Bedagai not irrigated, therefore the construction of weirs Bajayu an effort to provide a vital and strategic water.

Construction of Bendul Bajayu is the main building to be able to supplying irrigation water for 3 (three) irrigation areas ie Paya irrigation area Lombang (± 1,558 Ha), irrigated areahorsefly (± 2.000 Ha) and irrigation areas Bajayu (± 4,000 Ha) in SerdangBedagai which has been the availability of water is not sufficient because it only depends on the gabion,yang where serves as a flood control in Tebing Tinggi.

The development of irrigation area is a large scale development activities with government funds big enough, so it's clickingetahui issue at an investment costof fish on the project is feasible orto, then should this need at Analysis project is financially and economically.

2. Methods

Analysis of investment in the field of dam construction is to measure the value of cost and value of benefits.There are various ways to measure the value of costs and benefits. In this study will use the criteria of investment feasibility level by using the formula NPV, IRR, BCR and sensitivity analysis debagai parameters in determining the policy to be taken.

Research is done by collecting basic data of research done in field then data from field processed into form of systematic calculation. Further analysis of primary and secondary data obtained from the survey results in the field. After that a formulation that will be used is derived from the literature, and then performeda systematic analysis of the data.

3. Result and Discussion

this section will demonstrate the result of data collection from the field. Further analysis, base on various method will also be discussed in term of investment cost, operating cost, and maintenance cost. Moreover, additional factor such as benefit of the project, discontinuity factor, and sensitivity analysis will also be displayed to show the effectivity of the project.

3.1 Financial Analysis of The Project

The financial analysis aims to discus some aspects of the irrigation area. Such as investment cost, operating cost, and maintenance cost. Each variable will be analyzed and presented in detail.

3.1.1 Investment Cost

The Bendrat Bajayu Irrigation Project has been started from 2013 and will be planned for completion by 2022. The project age is planned for 35 years and the interest rate used in the financial analysis discount is 10% per annum in accordance with the average interest of banking credit in North Sumatra Province. Interest rate and the age of the investment was used as an assumption based on an analysis that seen in market and counstruction is 10 years old. Table 1 in below is described the design of total financial costs to be invested.

Table 1. Investment Cost of Bajayu Irrigation Area

Years -	Yeasrs	Financial Costs (Rp)
1	2013	22.773.253.060
2	2014	22.354.167.341
3	2015	22.354.167.341
4	2016	24.707.131.873
5	2017	24.707.131.873
6	2018	24.707.131.873
7	2019	30.093.647.858
8	2020	30.093.647.858
9	2021	30.093.647.858
10	2022	32.929.901.923
	Total	**226.517.379.151**

3.1.2 Operating Costs

Operating expenses Is the cost in the form of spending money to carry out the main activities, namely in the form of selling and administrative expenses to earn income, excluding expenses have been factored into the cost of sales and depreciation. The operational costs divided into 2 charges with conditions and conditions Without Project and With Project. The definition of project Operational Costs without Project which consists of seed, fertilizer, labor, or labor and cost for equipment. Seed which consists of rice seeds, and pulses. While the definition with the project is covering the costs for the budidaya of plants according to the planned cropping pattern. All costs with wtihout project and with the project can be seen in Table 2-5.

Table 2. The Need For Seed

No.	Seed	without Project			with Project		
		Needs (Kg/ha)	Unit price (Rp/kg)	Price (Rp/ha)	Needs (Kg/ha)	Unit price (Rp/kg)	Price (Rp/ha)
1	paddy	55	2.150	118.250	55	2.150	118.250
2	Corn	30	2.250	67.500	40	2.250	90.000
3	Soy	25	2.200	55.000	25	2.200	55.000
4	Peanuts	16	2.300	36.800	40	2.300	92.000
5	Green beans	16	2.300	36.800	-	-	-
6	Cassava	10	2.400	24.000	-	-	-
7	Sweet potato	10	2.400	24.000	-	-	-
			Total	**362.350**		**Total**	**355.250**

Table 3. The Need For Fertilizers

No.	Fertilizer	without Project			with Project		
		Needs (Kg/ha)	Unit price (USD/kg)	Price (USD/ha)	Needs (Kg/ha)	Unit price (USD/kg)	Price (USD/ha)
1	urea	42	1.800	75.600	80	1.800	144.000
2	TSP	22	2.450	53.900	40	2.450	98.000
3	KCL	45	2.350	105.750	40	2.350	94.000
			Total	**235.250**		**Total**	**336.000**

Table 4. The Cost of Workers' Wages

No.	Worker	without Project			with Project		
		Needs (Kg,day/ha)	Unit price (Rp/psn.day	Price (Rp / ha)	Needs (Kg,day/ha)	Unit price (Rp/psn.day	Price (Rp/ha)
1	labor Family	10	75.000	750.000	20	75.000	1.500.000
2	Labor heird worker	70	950.000	6.650.000	130	95.000	12.350.000
			Total	**7.400.000**		**Total**	**13.850.000**

Table 5. Needs Farm Equipment

No.	Equipment	without Project			with Project		
		Needs (Unit / ha)	Unit price (Rp/kg)	Price (Rp/ha)	Needs (Rp/ha)	Unit price (Rp/kg)	Price (Rp/ha)
1	Tractor hand	1	5.000.000	5.000.000	1	5.000.000	5.000.000
			Total	**5.000.000**		**Total**	**5.000.000**

3.1.3 Maintenance Cost

Bajayu irrigation area maintenance fee referred to in this study is covering the cost of routine maintenance, periodic maintenance costs among others that emergency maintenance. Maintenance

costs meant that includes the condition without project and with project conditions. As can be seen in table 6.

Table 6. Maintenance Costs

No.	Information	without Project	with Project
		Cost (Rp/year)	Cost (Rp/year)
1	Routine maintenance	10.787.770.644,12	17.979.617.740,20
2	Periodic maintenance	43.151.082.576,48	71.918470.960,80
3	Emergency maintenance	16.181.655.966,18	26.969.426.610,30
	Total	**70.120.509.186,78**	**116.867.515.311,30**

3.1.4 Miscellaneous Expense

Other expenses in without project and with project consists of tax, zakat, water levy. Tax derived from the total operational cost multiplied by 5% while the charity was obtained from the total operational cost multiplied by 2.5%.

3.2 *Benefit Project*

Benefit project financially is the multiplication of agricultural products produced on the land area is irigasibajayu with an average market price of each of the agricultural commodities produced in the city, cliffs tinngi, lubukpakam, and seirampah. Project benefit distinguished benefit "without project" and benefit "with project". Uraiaan about benefits the project can be seen in table 7 and table 8.

Table 7. Benefit without Project

No.	Commodities	Product (Ton / Ha)	Market price (Rp/Ton)	Benefit (Rp/ha)	Plant Size (Rp/Year)	Total Benefit (Rp/Year)
1	Paddy	4	8.400.000	33.600.000	7558	253.948.800.000
2	Corn	4.5	3.500.000	15.750.000	2000	31.500.000.000
3	Soy	3.5	9.000.000	31.500.000	1500	47.250.000.000
4	Peanuts	3.5	8.500.000	29.750.000	1700	50.575.000.000
5	Green beans	4.5	7.500.000	33.750.000	500	16.875.000.000
6	Cassava	15	2.500.000	37.500.000	1358	50.925.000.000
7	Sweet potato	7.5	3.500.000	26.250.000	500	13.125.000.000
			Total Benefit Without Project			**464.198.800.000**

Table 8. Benefit with Project

No.	Commodities	Product (Ton / Ha)	Market price (Rp/Ton)	Benefit (Rp/ha)	Plant Size (Rp/Year)	Total Benefit (Rp/Year)
1	Paddy	7	8.400.000	58.800.000	11337	666.615.600.000
2	Corn	6	3.500.000	21.000.000	1500	31.500.000.000
3	Soy	4	9.000.000	36.000.000	1500	54.000.000.000
4	Peanuts	4	8.500.000	34.000.000	779	26.486.000.000
			Total Benefit With Project			**778.601.600.000**

3.3 *Discounting Factor*

Discounting financial factor is the average interest money in banks in north sumatra commercially. From the results of observations carried out in several government and private bank in medan, lubukpakam, seirampah, and tebingtinggi then found commercial lending rate average is 10.25% per year. Thus, in preparing the cash flow and financial analysis of the project development bajayu irrigation area used discounting factor based on the average interest on loans are the 10.25% / year.

3.4 *The Calculation Results*

By using incremental benefit then financially magnitude decisison criteria obtained are as follows:

- Discounted B / c Ratio : $\frac{3.195.490.772.919}{563.929.306.552} = 5.67$
- discounted NPV : Rp. 2,631,561,466,367
- discounted IRR : 27.15%

C = ((-56,181,341,085) + ... + (- 24,546,099,982)) = -417,728,204,263 = 417,728,204,263
B = (76.986.695.699+ ... +15,332,228,839) = 3.049.289.670.630

- Discounted N / K Ratio : $\frac{3.049.289.670.630}{417.728.204.263} = 7{,}3$

From the calculation results obtained, that the discounted b / c ratio obtained by dividing the discount benefit and discount cost. Discounted npv is obtained from the sum discount balance. Discounted irr obtained from the calculation results column balance. Discounted n / r ratio is obtained from the sum discount column special balance ranging from the 11th until the 35th.

3.5 *Sensitivity Analysis*

To see the sensitivity analysis of the project, then performed simulations with incremental sensitivity analysis, and the results can be seen as follows:

a. By raising Benefit Stream of 5% of the obtained B / C ratio of 5.95, NPV2,791,336,005,013,IRR of 27.34%, and N / K Ratio amounted to 7.68
b. By raising Benefit Stream by 10% of the obtained B / c Ratio of 6:23, NPV2,951,110,543,659,IRR amounting to 27.93%, and N / K Ratio of 8.06
c. By lowering the Cost Stream of 5% of the obtained B / c Ratio sebesar5.96, NPV2,659,757,931,695,IRR amounting to 27.77%, and N / K Ratio of 7.70
d. By lowering the Cost Stream by 10% of the obtained B / c Ratio of 6:30, NPV 2,687,954,397,023, IRR of 27.56%, and N / K Ratio of 8.15.
e. By determining the Interest Rate (Discount Rate) of 8%, then the B / C ratio of 7:00, NPV 3,953,096,525,246, IRR of 27.34%, N / K ratio of 9.75.

3.6 *Economic Analysis Project*

3.6.1 Economic Investment Cost

Bajayu Weir Irrigation Project has been started from 2013 and will be completed in 2022. The planned project Age 25 years and the interest rate used in the economic analysis is 10% discount in accordance with the average rate of bank credit in the province of North Sumatra. Interest rate and the age of the investment was used as an assumption based on an analysis that seen in the market, and the construction is 10 years old.

It can be seen that the economic costs derived from the calculation of the construction cost of each done sequentially each year. at the Table 9 draft outlined the total cost of economic will be invested / in spending each year starting from 2013 s/d in 2022.

Table 9. Investment Costs of Irrigation Area Bajayu

To-Year	Year	Economic Cost (Rp)
1	2013	16.272.759.275
2	2014	15.973.299.159
3	2015	15.973.299.159
4	2016	17.654.623.531
5	2017	17.654.623.531
6	2018	17.654.623.531
7	2019	21.503.589.585
8	2020	21.503.589.585
9	2021	21.503.589.585
10	2022	23.530.251.279
	Total	**189.224.248.220**

3.6.2 Operating Costs

Operating expenses is the cost in the form of spending money to carry out the main activities, namely in the form of selling and administrative expenses to earn income, excluding expenses have been factored into the cost of sales and depreciation. The operational costs divided into two, namely the cost

of the project without any conditions and conditions with the project.the definition of operating cost project without project which consists of seed, fertilizer, labor, or labor and cost for equipment. Seed which consists of rice seeds, and pulses. While the definition with the project is covering the costs for the budidaya of plants according to the planned cropping pattern. All costs with wtihout project and with the project can be seen in table 10-13.

Table 10. Supplies of Seed

No	Seed	without Project			with Project		
		Needs (Kg/ha)	Unit price economy (Rp/kg)	Price Economy (Rp/ha)	Needs (Kg/ha)	Unit price economy (Rp/kg)	Needs (Rp/ha)
1	Paddy	55	2.150	118.250	25	2.150	53.750
2	Corn	30	2.250	67.500	40	2.250	90.000
3	Soy	25	2.200	55.000	25	2.200	55.000
4	Peanuts	16	2.300	36.800	40	2.300	92.000
5	Green beans	16	2.300	36.800	16	2.300	36.800
6	Cassava	10	2.400	24.000	10	2.400	24.000
7	Sweet potato	10	2.400	24.000	10	2.400	24.000
			Total	**362.350**		**Total**	**290.750**

Table 11. Supplies of Fertilizer

No.	Fertilizer	without Project			with Project		
		Needs (Kg/ha)	Unit price economy (Rp/kg)	Price economy (Rp/ha)	Needs (Kg/ha)	Unit price economy (Rp/kg)	Needs (Rp/ha)
1	urea	42	1.800	75.600	80	1800	144.000
2	TSP	22	-	-	40	2450	98.000
3	KCL	45	2.350	105.750	40	2350	94.000
			Total	**181.350**		**Total**	**336.000**

Table 12. Cost of Labor

No.	Worker	without Project			with Project		
		Needs (psn, Day/ha)	Unit price economy (Rp/psn. days)	Economic price (USD/ha)	Needs (psn, day/ha)	Unit price economy (Rp/Org. days)	Economic price (USD/ha)
1	Family workers	10	42.500	425.000	20	42.500	850.000
2	Wage laborers	70	53.833	3.768.333	130	53.833	6.998.333
			Total	**4.193.333**		**Total**	**7.848.333**

Table 13. Cost of Hand Tractors

No.	Equipment	without Project			with Project		
		Needs (Unit/ha)	Unit price economy (Rp/ha)	Economic price (Rp/ha)	Needs (Unit/ha)	Unit price economy (Rp/ha)	Economic price (Rp/ha)
1	Tiller	1	5.000.000	5.000.000	1	5.000.000	5.000.000
			Total	**5.000.000**		**Total**	**5.000.000**

3.6.3 Maintenance Cost

Bajayu maintenance costs of irrigation area in question in this research is covering the cost of routine maintenance, periodic maintenance costs among which meant maintenance emergency. Maintenance costs which includes conditions without project and with project conditions. The maintenance costs of irrigation area bajayu that in practice today (without project) rated less optimum evident from the condition of the channel and weir are not managed properly, it can be seen from the state of the pitch

in which the number of times the incidence of flooding of the river to enter the area of irrigation and resulting outcomes the harvest is not optimum. Estimated operating costs incurred on the project without any conditions are as shown in Table 14.

Table 14. Cost of Maintenance

No.	Information	without Project	with Project
		Cost (Rp/year)	Cost (Rp/Year)
1	Routine maintenance	873.762.762,35	1.456.271.270,58
2	Periodic maintenance	3.495.051.049,38	5.825.085.082,30
3	Emergency maintenance	1.310.644.143,52	2.184.406.905,86
	Total	**5.679.457.955,25**	**9.465.763.258,74**

3.6.4 Miscellaneous Expense

Other fees in without project and without the project consists of tax, zakat, water levies. Tax derived from the total operational cost multiplied by 5%, while zakat is obtained from the total operational cost multiplied by 2.5%.

3.7 *Benefit without project and with project*

Project economic benefits are the result of multiplication of agricultural products produced on the land area is Irigasi Bajayu with an average market price of each of the agricultural commodities produced in the city, TebingTinggi, Lubukpakam, and SeiRampah. Project Benefit distinguished benefit "without project" and benefit "with project". A description of the benefits of the project in question is as described in Table 15 and 16 following this.

Table 15. Benefit without Project

No.	Commodities	Product (Ton/Ha)	Price Economy (Border Price) (Rp/Ton)	Benefit (Rp/ha)	Plant Size (Ha/Year)	Total Benefit (Rp/Year)
1	Paddy	2,5	4.997.561	12.493.902	4023	50.265.466.257
2	Corn	2,8	1.655.391	4.635.094	2785	12.908.736.266
3	Soy	2,2	4.979.895	10.955.768	1490	16.324.094.771
4	Peanuts	2,2	8.454.306	18.599.474	1000	18.599.474.213
5	Green beans	2,8	7.500.000	21.000.000	675	14.175.000.000
6	Cassava	9,4	2.500.000	23.500.000	1560	36.660.000.000
7	Sweet potato	4,7	3.500.000	16.450.000	8	130.160.873
	Total Benefit Without Project				**11541**	**149.062.932.380**

Table 16. Benefit with Project

No.	Commodities	Product (Ton/Ha)	Price Economy (Border Price) (USD/Ton)	Benefit (USD/ha)	Plant Size (Ha/Year)	Total Benefit (USD/Year)
1	Paddy	7	4.997.561	34.982.925	4023	140.743.305.519
2	Corn	6	1.655.391	9.932.344	2785	27.661.577.714
3	Soy	4	4.979.895	19.919.579	1490	29.680.172.311
4	Peanuts	4	8.454.306	33.817.226	1000	33.817.225.841
5	Green beans	6	7.500.000	45.000.000	675	30.375.000.000
6	Cassava	15	2.500.000	37.500.000	1560	58.500.000.000
7	Sweet potato	8	3.500.000	28.000.000	8	221.550.422
	Total Benefit With Project				**9298**	**231.902.281.385**

3.8 *Discounting Factor*

Discounting economic factor is the average interest money in banks in North Sumatra commercially. From observations which I did on several government and private bank in Medan, Lubuk pakam, Sei Rampah, and Tebing Tinggi then I obtained a commercial loan rate average is 10.25% / year. Thus, in

preparing the cash flow and economic analysis of development projects I use irrigation area Bajayu Discounting factor based on the average interest on loans are the 10.25% / year.

3.9 *Decision Criteria*

3.9.1 The Method of Calculation Used

The concept, structure and calculations on a computer program that is used is consistent with the recommended Price Gittingers J. (1982). Years earlier than the project was taken one year after project start and from the initial year-0 (year 0).

3.10 *The Calculation Results*

By using incremental benefit, the economic magnitude of decisison criteria are obtained are as follows:

- Discounted B / c Ratio : 6,92 $\frac{1.443.623.871.360}{208.585.466.380}$
- discounted NPV : Rp.1235038404979.95
- discounted IRR : 32.35%

C = ((-14,803,091,668) + ... + (-11,670,524,446)) = -122,828,294,101 = 122,828,294,101
B = (47.884.471.632+ ... + 15,332,228,839) = 1.357.866.699.081

- Discounted N / R Ratio : $\frac{1.357.866.699.081}{122.828.294.101}$ = 11.05

Discounted b / c ratio obtained by dividing the discount benefit and discount cost. Discounted npv is obtained from the sum discount balance. Discounted irr obtained from the calculation results column balance. Discounted n / r ratio is obtained from the sum discount column special balance ranging from the 11th until the 35th row is then divided by addition discount column special balance from year 0 to 10.

3.11 *Sensitivity Analysis*

To see Sensitivity analysis of the project, then performed simulations with Incremental sensitivity analysis, and the results can be seen as follows:

a. By raising Benefit Stream of 5% of the obtained B / C ratio of 7.27, NPV 1,307,219,598,548,IRR of 32.92%, and N / K Ratio 11.64.
b. By raising Benefit Stream by 10% of the obtained B / C ratio of 7.61, NPV1,379,400,792,116,IRR of 33.47%, N / K Ratio of 12.23.
c. By lowering the Cost Stream of 5% of the obtained B / C ratio of 7.29, NPV1,245,467,678,299,IRR of 32.95%, N / K Ratio of 11.67.
d. Cost Stream by reducing by 10% the obtained B / C ratio of 7.69, NPV1,255,896,951,618,IRR of 33.59%, N / K Ratio 12.36.
e. By determining the Interest Rate (Discount Rate) of 8% B / C ratio of 8.08, NPV1,811,968,205,849,IRR of 32.35%, N / K Ratio of 14.54

4. Conclusion

After doing all the stages of this research method, in accordance with the formula and framework beginning, it was found that the variable risks identified affect the rate of return on investments in the weir bajayu, that delay construction, inflation, Debt interest rate, market price changes, and Changes in currency exchange rates. Results obtained financial analysis NPV of Rp.1.778.603.070.507 with an IRR of 27% and a BCR of 4.6. Economic analysis results are also obtained NPV of Rp.1.235.038.404.979 with an IRR of 32% and a BCR of 6.92. Sensitivity analysis is also performed to changes in costs and benefits of ± 5% and ± 10% for financial and economic analysis, and the results show that the project development plan is still very viable.

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