The Feasebility Analysis of Public Investment: Evidence of Reservoir

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Keywords: Indonesia, Reservoir, Feasibility Analysis, Economic Analysis

Abstract: Farmers need water urgently, especially in District of Gunungkidul, because their farm's irrigation depend on rainfall. It is not a lucky condition. They face drought in dry season, but rudundant water is in rainy season. Moreover, their area covered by water significantly. Therefore, irrigation management is urgent for the local government, such as build a reservoir for providing water supply constantly. This study aims to perform feasibility analysis approach, namely net present value, benefit cost ratio, and internal return rate. This study also implement sensivity analysis through different schema of interest rate. Prior research has implemented economic analysis to examine public investment, but in this case, the reservoir's project has to release communities' land and communities' vegetation. This study reveals that the project of Embung Kedung Poh is eligible to execute and this result contributes to reseach about public investment that have to sacrifice private land and vegetation.

1 INTRODUCTION

Farmers who depend on field, farm, or livestock to earn money consider the important role of water in their life. According to sustainable water supply, farmer needs guarrantee that their field or farm get enough irrigation in order to optimize the growth. However, the increasing of population affects to increasing of food, therefore an irrigation management should consider the need of food beyond to the population (Indarto, 2012). As a consequnce, management of irrigation also involve analysis of public investment. This analysis requires an understand about feasibility of project, so the result of study regards to decide whether project be able to be implemented or not (Jo et al., 2015).

A study about public investment reveals that Hundred Billion Plan in Cina could increase food output significantly approximately 4.34% from 2007 – 2013 through improving productivity (He et al., 2019). In general, public investment has negative relationship with debt to GDP ratio, especially in short term, and public investment can also reduce unemployment rate in short term (ADB et al., 2016).

This study examines the public investment in Nglipar Subdistrict of Gunung Kidul District, Special Region of Yogyakarta Province. Generally, people in Subdistrict of Nglipar, District of Gunungkidul works as farmer, so they depend on irrigation as water supply to grow their plants and vegetables. Unfortunately, the irrigation supply is only provided by rain, so in several times, they experience crop failure, especially when the lack of rain intensity. Therefore, local government has to build a reservoir (as Javanese People called it as embung) to guarantee the consistency of water supply for the farmers.

According to the geography characteristic of Subdistrict of Nglipar, District of Gunungkidul, the reservoir (embung) mainly accommodates the overwhelming water during rainy season. Actually, infertility soil in this distict also deteriorate the productivity of farmers, so the reservoir also has a function to reserve abundant water supply during rainy season. Therefore, the reservoir has two functions: contribute to water supply during dry season and reduce the volume of flood during rainy season.

Prior research such as (He et al., 2019) implement internal return rate as benefit cost analysis on China's Hundred Million Plan to estimate the project's economic return. (Jo et al., 2015) combine system dynamics (SD) and agent based modelling to examine the project's feasibility and in the system dynamics step, the analysis uses NPV and B/C ratio. This study also use NPV, B/C ratio, and IRR for project's economic analysis, but this study have to consider the value of vegetations that are obviously sunk under the water and the value of field that is released for the reservoir project. Therefore, this study performs sen-

Sardi, ., Sumbodo, B., Nurim, Y. and Hasthoro, H.
The Feasebility Analysis of Public Investment: Evidence of Reservoir.
DOI: 10.5220/0009877700480053
In *Proceedings of the 2nd International Conference on Applied Science, Engineering and Social Sciences (ICASESS 2019)*, pages 48-53
ISBN: 978-989-758-452-7

sivity analysis to estimate the project's return on several cost and interest rate schema.

This aim of study is to contribute to reseach about public investment that recently focus in railway, airport, energy, because the reservoir commonly is built naturally. The second contribution is the cost benefit analysis relate to private land that should be sacrificed for this project. The next detail below will describe about area and data, and finally this study will describe the analysis of net present value, benefit to cost ratio, and internal rate of return and implication of the analysis.

2 METHODOLOGY

2.1 Area and Data

The Kedung Poh Reservoir lies on Kedung Poh Lor Village, Nglipar Subdistrict of Gunung Kidul District, Special Region of Yogyakarta Province and approximately + 530 metres above sea level (MASL) (see figure 1). The building of this reservoir implements a rainfall management system, because the source irrigation of the reservoir comes from rainfall. Therefore, the reservoir will be built through a soil dig. This study uses the project costs include operating costs, legal consulting cost, and administration and contingency cost. Then, this study emphasizes in both cost and benefit aspects based on the project costs.

2.2 Analysis

This study performs economic analysis, such as nett present value, benefit to cost ratio, and internal rate of return. This analysis of project focus in from economical perspective with several cost and return alternative for sensivity analysis. There are some asumption, such as project uses a shadow price as price indicator uses shadow price, project analysis exclude tax payment, and market price of goods that is resulted by farmer must include government's subsidy (Suyanto et al., 2001). The detail of economic analysis formula be described below. First, net present value indicate the progress of project's profit economically, so this analysis compares cost and benefit regarding in cost rate of project or interest rate of bank. The formula of present value (PV) uses formula of (Kuiper, 1971) and (De Garmo and Sullivan,).

$$PV = \frac{F}{(1+i)^n} \tag{1}$$

Notes:
PV: present value
F: year x (cardinal) variable
I: interest rate
N: first,second,third year (ordinal)....so on

According to net present value evaluation, current loan of interest rate should exceed to 0 (morethan zero). It means that project will result profit or as a profitable project. If the net present value of project has value zero, so the return of project is not more than the initial investment. However, if net present value of project is less than zero, it indicates that the project has to be delayed. It also imply that the project does not have benefit economically. For economic analysis, this study also consider net present value of cash out flow scenario based on several discount rate (I) alternative.

Figure 1: The location of Kedung Poh Reservoir

Second, analysis benefit to cost ratio is a comparison present value of cash in flow that shows the project's value and present value of cash out flow (total investment costs of maintenance) that indicates the project's cost. This comparison is based on determined discount rate (i) that is formulated by (Kuiper, 1971) and (De Garmo and Sullivan,).

$$BCR = \frac{\sum_n^{t=1} \frac{Bt}{(1+I)^t}}{\sum_n^{t=1} \frac{Ct}{(1+I)^t}} \tag{2}$$

Notes:
I: dicount rate
t: year index

According to benefit to cost evaluation, if the value of comparison has more than 1 ($x > 1$), it means the project has profitability. However, if the value of ratio is less than 1 ($x < 1$), it means the project should be delayed. The project can not be able to earn profit.

Third, this study also analyze the internal rate of return that shows discount rate (I) causes the value of net present value has zero. The calculation of interanl rate of return includes cash out flow and cash in flow per year. This study performs several schema of rate that has assupmtions as followed below :

a We should assume the discount rate (I) that has value as close as IRR variable. Then we calculate

NPV variable per year and NPV's cummulative.

b The value of discount rate (I) should b modified as accurate as possible to seek the cummulative of NPV's value equal to zero at the end of the project. This study also implement convergency approach as a possible way to seek the value of NPV's cummulative that closes to zero (Kuiper, 1971) (De Garmo and Sullivan,). The formula of IRR is stated as below:

$$IRR = I' + \frac{NPV}{NPV' - NPV'}(I" - I') \qquad (3)$$

Notes:
I' :first trial
II": second trial
NPV': first cummulative NPV variable
NPV": second cummulative NPV variable

After the analysis of NPV, B/C ratio, and IRR, the second step is an sensivity analysis that considers the probability of project's return based on the possibility of project's cost and profit. This approch is important in project's analysis because we have to predict the possibility of poject's profit based on rate changing. There are four assumptions to consider in sensivity analysis: cost overrun, a change in price compare to price level in general (for exampledecreasing price on agricultural products), delayed time for the project execution, and project's result deviation. According to sensivity analysis, this study uses any kind of conditions as followed (Suyanto et al., 2001): normal condition (stable worth and fixed cost), cost condition increased up to 10% stable worth,cost condition increased up to 10% worth decreased up to 10%, and cost condition decreased up to 10% worth increased up to 10%.

3 RESULTS AND DISCUSSION

3.1 Economic Analysis

This study calculates project's cost, such as land releasing cost, construction cost, and operating and maintaning cost, and project's benefits, such as irrigation, fishery, and recreation (see table 1). The project proper analysis is done based on the calculation of the project costs by applying NPV, B/C ratio and IRR variables, with current interest rate up to 12 %. The detail of analysis as depicted below.

First, estimated project's cost is an estimation of resources that is required by a project, namely Embung Poh Reservoir. This study calculates inital investment of project and project's benefit, such as the amount of project costs is calculated in detail as followed, namely land releasing cost, contruction cost, and operating and maintaining cost. Land releasing cost is an acquiring cost of land owned by community affected by this project. The community also plant vegetable plants and trees, such as manggo, banana, coconut, to earn money from it. Therefore, this study estimates the cost of dry field and the value of vegetation. Concerning on the land of Embung Kedung Poh covers approximitly 5.000 m. The total cost of land is IDR200,000,000, includes released land, vegetation, and trees price. Constructing cost is a building cost of the reservoir and facility surrounding the reservoir from reservoir's blueprint until the reservior able to irrigate the land. Estimated construction cost is IDR3,000,000,000, include blue print, planning, drainage, spillway building, fence surrounding reservoir, and gazebo and sign board. Operating and maintaining cost is a cost to optimize the reservoir's benefit. This study estimates 2% of constructing cost as estimated maintaining cost, namely IDR60,000,000.

Second, Calculation of project's benefit is an analysis the possibility of benefits that can be taken by society sorrounding the project directly and indirectly. Therefore this study analyze direct benefit, such as irrigation and fishery, and also indirect benefit, such as water tour and recreation. Analysis of irrigation is an analysis of the reservoir's benefit to irrigate field and create other possibility economic's benefit from the abudant of water source. This study assumes that the cost of land's cultivation, land's fertilization, pest prevention, and harvest approximately 25% of harvest's value and crop productitvity. If the field can result 3 tons per hectare of crop in one period of plantation and the farmers can plant the field three times in a year. It also assume the price of harvest is IDR10,000 per kilogram, so the revenue can be calculated as follow: (1.0 – 0.25) x (3 x 10.000 x 1000) = IDR22,500,000 per year per hectare.

Table 1: Economic Analysis

No	Criteria	Cost(IDR)
Estimated Project's Cost		
1	Land Releasing Cost	200, 000,000
2	Construction Cost	3,000,000,000
3	Operating and Maintaning Cost	60,000,000
Total of Project Cost		3,260,000,000
Project's Benefit		
1	Analysis of Irrigation	355,000,000
2	Analysis of Fishery	112,200,000
3	Analysis of Fishery	112,200,000
Total of Revenue within a Year		474,400,000

This study also assume that farmers able to plant palawija (a kind of crop that does not need much water in growing, such as beans, corn, chili, casava, or sweet potato) 2 times within a year and it is predicted producing 2 tons per hectares. The farmer can sale within IDR5,000 per kilogram of palawija. If the cost of plantation is approximately 35% of the harvest's value, so the revenue of two times in harvest is 2 x 2 x 1000 x 0.65 x IDR5,000 = IDR13,00,.000. Therefore, this study assumes the farmer who has 5 hectares of field will result approximately IDR355,000,000 within a year (10 x (IDR22,500,000 + IDR13,000,000)).

Analysis of fishery is an analysis to predict the reservoir's extraordinary result. This study assumes that a pond within 1 m3 is optimum for approximately 10 fish and net profit from fishery is IDR30,000.00 within 8 months. According to the volume of reservoir aproximately 3,740 m^3, the reservoir results profit IDR112,200,000. Analysis of profit from recreation activity, such as water tour, also can be predicted and it is based on the number of reservoir's visitor. If there are 10 persons/each day and each of visitor has to pay IDR2,000.00, therefore revenue from recreation activity is approximately IDR7,200,000 within a year.

Based on estimated project's cost, the total of initial project's investment is IDR3,200,000,000 and the project's operation cost is IDR60,000,000 within a year. This study also estimate the project's benefits and the estimation of reservoir's result is IDR474,000,000 within a year. The next step is to analyze NPV, B/C ratio, dan IRR of project. Why is the analysis impoartant? The project requires investment and operating cost, but the project's benefits only can be acquired periodically after project's building.

Table 2: The Economic Analysis of Embung Kedung Poh

No	Discount Rate (i)	NPV (IDR)	B/C Ratio	IRR(%)
1	8%	1.834.573.580	1.467	
2	10%	1.019.098.513	1.267	
3	12%	398.169.008	1.107	13.62
4	14%	(83.367.534)	0.977	
5	16%	(463.340.090)	0.871	

The analysis of NPV, B/C ratio, and IRR need assumptions as stated follow (Salsabiila, 2016): discount rate up to 12%, the length time of the project up to 25 years, the length time of constructing up to 1 year, the optimum estimated land developing after 10 years, the benefit increases during the term of the time in line, 1 US$ = IDR10,000 and the bank's interest rate up to 12.00%. Based on that assumption, the result of analysis is NPV = IDR398,169,008, B/C ratio = 1.107, and IRR = 13.62% (see table 2).

The analysis of NPV determines the execution of the project whether fixed or unfixed. If NPV > 0 means a project is fixed economically. According to NPV analysis with bank interest rate up to 12%, project results IDR398,169,008, so the project of Embunng Kedung Poh has fixed economically. The analysis of B/C ratio reveals that the project is also fixed economically, because the value of B/C ratio is more than 1 (one). The analysis of IRR is based on discount rate determination, which all future revenue possibility is predicted in certain discount rate. Therefore this study calculates IRR's value in some interest rate schema, such as smallest positive NPV and smallest negative NPV.

3.2 Sensivity Analysis

The second step of the analysis is a sensivity analysis that describes several economic result on several assupmtions. This study applies present worth (PW) method to capture the several possibility of economic value. As an ilustration, this study determines the interest rate i.=.12% , so the value of NPV is IDR398,169,008. If this study determines the interest rate i.=.14%, so the value of NPV is IDR- 83.367.534 (see tabel 2). This study also consider the value of IRR up to 13.62%. If the value of IRR is higher than market return that has interest rate up to 12 %, so the project is economically eligible to execute.

This study also apply different schema of interest rate to reveal different of economic result, such as detailed in three schema. First, this study assumes that cost increases up to 10% within stable benefit, so the study reveals that the value of NPV = IDR346,071,967 (positive), the value of B/C ratio = 1.092, and the value of IRR = 13.41%. Second, this study assumes that the benefit of project decreases up to 10% within stable cost, so this study reveals that the value of NPV = IDR13,744,934 (negative), the value of B/C ratio = 0.996, and the value of IRR = 11.94%. Finally, this study assumes the cost increases up to 10%, but the benefit of project decreases up to 10%. Therefore, the value of NPV = IDR65,841,976 (negative), the value of B/C ratio = 0.983, and the value of IRR = 11.73%. This sensivity analysis indicates that the optimum of IRR's value approximately on 12% interest rate, because the value of NPV and the value of B/C ratio has lowest.

This study implements feasibility analysis on reservoir's project kedung poh (embung kedung poh) at District Gunung Kidul and the analysis includes

economic analysis and sensivity analysis. Result shows that this project is eligible to execute. Prior research has implemented feasibility analysis on public investment because it enhances understanding decision maker about project's viability (Jo et al., 2015). Study of (Jo et al., 2015) consider dynamic aspects ecompass micro level or system level and micro level or individual level. The effect of macro level relates to economic, social, and environmental effect, but the effect of micro level relates to individual who interacts to the project directly. Therefore, (Jo et al., 2015) analys benefit, cost, feasibility (NPV and B/C ratio) of project. According to the agents who are possible affected by project, (Jo et al., 2015) predict individual who can not do activities during the project contruction. However, this study considers the community's sacrifice such as land, field, and vegatation for the reservior project.

Study of (He et al., 2019)) implement benefit – cost analysis, namely internal return rate (IRR), forHunderd Billion Plan in China form 2007 – 2013 and the analysis is to understand the effcientcy level of project. This program has an objective to enhance food security, so this investment has impact to large scale output. According to (He et al., 2019), the investment are categorized into irrigation, land improvements, and farm support because the three kinds of project support HBP output directly. According to kedung poh reservoir, this study also consider fishery and recreation benefit of project beside irrigation benefit. The community sorrounding the reservoir can earn from fishery that be culltivated or developed together by this community.

Study of (Rolfe, 2019) about public investment evaluation in sporting events in Australi implements evaluation stage that involve possible generated benefit from this project. Therefore, the study identifies direct benefit, such as spending for local economy, tourism attraction, and attraction synergies, and intangible benefit, such as additional positive images for the local community or region (Rolfe, 2019). According to kedung poh reservoir, water recreation also become positive effect of the project, however this study only consider the minimum income from recreation. We predict that if the local government encourages local community manage the potential water recreation profesioanally, so community earns optimum indirect benefit from kedung poh reservoir

Next study should be performed especially about the water quality of this reservoir. Why is it important? The infertility soil characteristic of District Gunung Kidul causes the community severe by drought longer than other Distict at Yogyakarta Province. Therefore, the community can take benefit from reservoir to supply clean water. However, the intensive research should be done because the quality of water has impact for the community health. For an ilustration, based on compiled data within 13 years of 142 lakes and reservoirs in China, an empirical study reveals that the quality of water increases during 2005 – 2013, although during this period, the pollutan is stable. However, the pollutan of water decreases during 2014 – 2016. This study also reveal that eutrophian causes the deteroriation of China's lakes and reservoir during 2005 – 2011, but heavy metal pollution causes the reduction of water quality in China's lakes and reservoirs during 2011 – 2017. The non point source pollution indicates China needs a consolidation effort of government on ecosystem and environmental management (Huang et al., 2019). (Kerr et al., 2016) suggest that the involvement of farmers on conservation program be able to reduce the sediment of non point source pollution. ((Kerr et al., 2016).

4 CONCLUSIONS

This study be encouraged by the unique characterictis of public investment, namely kedung poh reservoir, such as realising cost from community land and vegatation, indirect benefit from fishery and water recreation, although the main objective of reservoir's onstruction provides irrigation supply constantly. Based on the feasibility analysis, this project is eligible to execute. The next study should be performed regarding to water quality analysis, because the drought problem during the dry season.

ACKNOWLEDGEMENTS

Thankfull to Seia Cons that has already provided us with some facilities on the project of Embung Kedung Poh in subDistrict of Nglipar, District of Gunungkidul, Special Region of Yogyakarta.

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