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Technical Economy Study on Jurang Jero Small Dam Construction Project In Blora Regency

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Abstract-One effort to improve the water resources sector in the field of water needs is to build a container of water reservoir either in the form of natural container shelters like situ or artificial storage containers such as small dam. The aim of this research is to know the benefits of Jurang Jero small dam construction in terms of technical economic aspects obtained from irrigation water and raw water for Jurang Jero small dam construction project. The research method is descriptive quantitative with NPV analysis technique, Net B / C, IRR and sensitivity analysis. Quantitative data in the form of project costs, agricultural and fishery data are needed to calculate project benefits. Primary data retrieval technique using interview.

***Keywords*:** ekonomi teknik, small dam, Jurang Jero

1. Introduction

Water infrastructure has a very important role as a provider and distribution of clean water to meet the needs of irrigation and daily necessities.

The availability of water in the dry season is still a problem that has not been fully solved by the government in order to meet the needs of the community, among others due to the increasingly scarce water source due to deforestation and uncontrolled water use.

One effort to improve the water resources sector in the field of water needs is to build a container of water reservoir either in the form of natural container shelters like situ or artificial storage containers such as small dam. One of the water reservoirs to be built is the small dam Jurang Jero in Blora Regency.

Before commencing the construction of small dam Jurang Jero, a feasibility study is first undertaken to analyze whether the project is feasible or not feasible to build. The feasibility study of a research project includes: technical analysis, economic analysis, social analysis and environmental analysis.

These four analyzes are the standard that must be implemented on the feasibility study of a project. Based on the above description, this research is interested to discuss the feasibility study of Small Dam Jurang Jero construction project in Blora Regency which is focused on economic field.

The aim of this study is to know the benefits of small dams Jurang Jero construction in terms of technical economic aspects obtained from irrigation water and raw water on small dam Jurang Jero construction projects such as agriculture, fisheries, tourism. Second, to know the amount of comparison between benefit cost and benefit ratio and internal rate of return. Third, when the occurrence of Break Even Point.

While the problem formulation of this research is : first, What is the benefit obtained from irrigation water and raw water for small dam Jurang Jero construction project such as: agriculture in rupiah units, fisheries in rupiah units and also tourism in rupiah units. Second: What is the ratio between the benefit cost ratio and the internal rate of return?

2. Literature Review

Small dam is another name of the reservoir. A small dam is a dam that does not meet the requirements of a large dam. According to the definition adopted by ICOLD (International Commission on Large Dams) in 1932 in Brown (1964) large dams are: Dams that are over 15 m high, measured from the bottom to the top of the dam. According to Soedibyo (1993), a high dam between 10-15 m can also be called a big dam if it meets one or more of the following criteria::

- The peak length of the dam is not less than 500 m
- Capacity of the reservoir that is formed not less than 1 million m^3
- Maximum flood discharge calculated not less than 2000 m^3 / sec
- The dam faces special difficulties on its foundation
- The dam is not designed as usual

The conditions above are not absolutely binding, because in the implementation of the field there are dams that meet the requirements of large dams named "embung" and vice versa. A small dam of fill type (with a height of less than 15 meters) does not require a special design. Nevertheless Mulholland (1987) in Muslimin (2016) issued general guidelines for the design of small dams of homogeneous pile type of soil.

1. Foundation

   The most important foundation requirement for an fill type dam is a foundation capable of supporting embankment, and which is sufficient to withstand seepage. There are 3 kinds of foundations suitable for small dam buildings such as rock foundation / hard ground, sand / gravel foundation and silt / clay foundation..

2. Stability Dump

   The slope of the pile should be stable during construction and under all conditions of the joint operation, including the rapid drawdown condition.

3. Width of Peak Dam

   The minimum peak width is the width that will provide a secure grid of percolation along the heap at full storage. Because in practice, it is very difficult to determine this peak width factor. Usually the width factor of the peak is used empirical approach and follows the recommended equation for small dam of urugan type of soil:

   $W = H / 5 + 3$

   W is the width of the top of the dam, and H is the height of the dam.

4. Seepage On Dumps

   The seepage of the dam must be controlled so that there is no internal erosion and no scouring occurs in the area at the time of seepage.

5. Spillway Design

   Spillway is usually designed so that it can pass 100 year annual flood discharge with a freeboard of 300 mm. For a spillway that fuses with a dam body, speed at the top and downstream slopes should be sufficient to withstand erosion.

6. Upper Slope Protection

   Upper slope surfaces require protection against waves / wave erosion if the water catch is large enough. Upper slope protection forms may be rip-rap rocks, rock piles, or other suitable forms of protection.

There are several investment criteria that can be used in project evaluation: (1) Net Present Value (NPV), (2) Internal Rate of Return (IRR), (3) Net Benefit Cost Ratio (Net B / C), (4)) Payback Period.

a. Net Present Value

   It is the difference between benefit (revenue) and cost (expenditure) that has been presented (Mulyadi, 1991). If NPV is positive, it means the project is profitable, whereas if the NPV is negative the project is not feasible to run because it is not

profitable.

$$NPV = \sum \frac{Bt-Ct}{(1+i)}$$

(1)

Information:

Bt = The total benefit value (revenue) in the 1st year

Ct = Cost (cost) in year t, consisting of fixed costs, variable costs, overhead costs, administrative and general costs.

n = the project's economic life

i = discount rate

Criteria:

- If NPV ≥ 0, then dam construction is feasible to be implemented
- If NPV <0, then the dam construction is not feasible to implementation.

b. Internal Rate of Return (IRR)

It is the interest rate that describes the benefits (acceptance) that have been presented and the cost (expenditure) that has been presented is equal to zero. Thus the IRR indicates the project's ability to generate the returns or the level of profit it can achieve.

$$IRR = i_1 + \frac{NPV_1}{NPV_1+NPV_2}(i_2-i_2)$$

(2)

Information :

NPV1 = NV that is positive (smallest)

NPV2 = NPV with negative value (largest)

i1 = Interest rate on NPV is positive

i2 = Interest rate on NPV is negative

i2 - i1 = Can not be more than 5%

Criteria:

- If IRR ≥ 1, then dam construction is feasible to be implemented
- If IRR <1, then dam construction is not feasible to implement.

c. Net Benefit Cost Ratio (Net B/C Ratio)

Net Benefit Cost Ratio (Net B/C) is a comparison between the value of net benefit of the years concerned (numerator/positive) with the present value of cost flow in the year in which Bt-Ct (denominator/negative).

$$\text{Net B/C Ratio} = \frac{\sum_{t=0}^{n} \frac{Bt-Ct}{(1+i)}}{\sum_{t=0}^{n} \frac{Ct-Bt}{(1-i)^t}}$$

untuk Bt-Ct > 0

untuk Bt-Ct < 0

(3)

Information:

Bt = The total benefit value (revenue) in the 1st year

Ct = Cost (cost) in year t, consisting of fixed costs, variable costs, overhead costs, administrative and general costs.

n = the project's economic life

i = discount rate

Criteria:

- If Net B / C ≥ 1, then dam construction is feasible to be implemented
- If Net B / C <1, then dam construction is not feasible to implement.

d. Payback Periods

Payback periods are the periods / periods required to pay back all the costs incurred in the investment of a project.

$$\text{Payback Period} = \frac{I}{Ab} \quad (4)$$

Information:

I = amount of investment cost required

Ab = net benefit that can be obtained every year

e. Analisis Sensitivitas

In project evaluation always dealing with the future (futurity), both benefits to be gained as well as all sorts of cost incurred. In the future many things or uncertain changes may occur. Uncertainty is tried to be seen with sensitivity analysis. So sensitivity analysis is really a tool to analyze the risk and uncertainty problems that a project might face in the future.

3. Research Methods

The feasibility study is a study involving various aspects of legal, socioeconomic and cultural aspects, market and marketing aspects, technical and technological aspects up to management and finance aspects, where they are used for basic feasibility studies and the results are used to make decisions whether a project or a business can be done or postponed and not even executed.

While the engineering economy focuses on how to make a decision which is limited by the variety of problems associated with an engineer to produce the best choice from a variety of alternative options. Alternatives arise because of the limitations of resources (human, material, money, machines, opportunities, etc.). Technical economics is a necessary calculation to get the best option economically, both when comparing different alternatives, scaling up capital investment decisions, evaluating financial opportunities and so on. Thus technical economic analysis involves making decisions on a limited range of resource uses.

This research was conducted on small dam Jurang Jero construction project which is administratively located in two villages namely Nglengkir Village and Jurangrejo Village, Bogorejo Sub-district, Blora Regency.

Operational definition variables in this study include:

1) Construction Cost

Construction costs are the costs that are required directly for the construction of good for the construction of irrigation channels, excavation, and others in rupiah units.

2) Benefit (Benefit)

Benefit (benefit) is the benefit obtained from the existence of small dam in the form of the sale of clean water in the period of thirty years in rupiah units. The derived benefits of the Small Dam Jurang Jero construction project are as follows:

a. Agriculture sector

Project benefits are derived from increasing agricultural production from agricultural production prior to the project and after the small dam Jurang Jero project. Planting pattern planned in the study areas are: Rice and Palawija. These benefits include benefits that can be measured economically (tangible

benefits).

These benefits can be calculated by the following formula:

$$IT = \sum_{i=1}^{n} \frac{Pi}{T} \times 100\% \quad (5)$$

Information:

IT = Crop Intensity (times)

Pi = Planted area in season i (hectare)

T = Area of raw land (hectare)

i = Plant type in the planting season to i

n = Number of planting seasons in 1 year (times)

The above formula is used to see the intensity of planting diareal of land that flowed water from small dam by considering the type of plant. According Soekartawi (1995), acceptance of farming can be done by multiplying the amount of production obtained with the selling price.

$$TR = Y \times Py \quad (6)$$

TR = Total Receipts (Rp)

Y = Production Result (Ton)

Py = Price y (Rp)

b. Field of Tourism

The benefits of small dam's construction for economic tourism are derived from the sale of admission tickets to tourists, parking and kiosk rents from merchants around small dam. This benefit falls into the category of tangible benefits because the benefits can be measured economically.

c. Field of Fishery

To calculate the benefits of small dam Jurang Jero construction in this fishery field can be used profit analysis formula. This analysis aims to determine the profits derived from the business conducted in one production cycle. Mathematically formulated as follows.

$$\pi = PyY \sum_{i=1}^{n} PxiXi \quad (7)$$

Information :

π = profit (Rp per season)

Y = total production (kg per hectare / season)

X = number of inputs used (unit)

Py = price per product unit (Rp)

Pxi = price per unit of imput (Rp)

Py.Y = Total revenue = TR (Rp)

Pxi.Xi = Total Spending = TC (Rp)

To find out the feasibility level of small dam construction project of Jurang Jero in Bogorejo Sub-district, Blora Regency, Net Present Value (NPV), Internal Rate of Return (IRR) and Net Benefit Cost Ratio (Net B / C) used in this data analysis can be seen in the formulas (1) through (4) above.

To know the extent of the impact of small dam construction on socio-economic conditions of society conducted by descriptive analysis techniques through tabulation of data designed on excel program, further measurements include.

a) Characteristics of farmers, namely age, education and gender
b) Area of land and crops so that from this data can assess the income of farmers with or without the development of irrigation.

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