IOSR Journal of Economics and Finance (IOSR-JEF)
e-ISSN: 2321-5933, p-ISSN: 2321-5925. Volume 12, Issue 2 Ser. IV (Mar. –Apr. 2021), PP 49-53
www.iosrjournals.org

Benefits Cost Ratio Analysis of Urban Drainage

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Abastact
Disasters, floods and other natural disasters caused by human activities, tend to increase in intensity and complexity, so the losses continue to increase from year to year. Therefore, for each development project plan, the level of economic, financial, and social feasibility must be calculated in advance, so the project in addition to being economically useful, also has a high benefit value for the community.
Disaster loss assessment methods can be classified into losses witout project; 1) Direct Losses, 2) Indirect Losses. Before the feasibility analysis is carried out, it first needs to be examined and analyzed about the benefits, namely the added value both directly and indirectly from the construction of X-City drainage system. An analysis of economic benefits is needed to measure the rate of return calculated among others based on the benefits of saving costs of repairs and maintenance of houses, savings in medical and health care costs, travel time and transportation costs, accident saving for precautions, and the development of the area caused by the existence of the system adequate city drainage.
Based on the results of these calculations, it can be said that the planned construction of X-City drainage system has a good economic value with an NPV of IDR 5,017,274,269, and a benefit cost ratio (BCR = 1,045). Based on this analysis, the drainage project is economically feasible to be realized.

Date of Submission: 29-03-2021 Date of Acceptance: 12-04-2020

I. Introduction

In recent years, the phenomenon of flooding in several major cities in Indonesia is quite alarming, given the impact that flooding is so widespread and causes considerable losses to the community, both in the form of material and immaterial losses, and even in some cities that were affected by floods, it has caused casualties. This condition certainly needs serious attention to immerdiately find a way out of handling urban floods in a comprehensive manner. At least every city needs to review its exsisting urban drainage system. The urban drainage system is an inseparable component of the development plan and development of the city, and it should work as a surface control infrastructure that can reduce waterlogging and flooding, also can help create a comfortable, clean and healthy community life. For this purpose, each city must have an adequate urban drainage master plan layout. The drainage system must function as a transmission that can drain clear water from certain sources to various destinations, as well as be able to control wasterwater and puddles, and drain it through the primary channel to the final destination.

The construction of the city drainage system must be planned in such a way that in the construction process it can produce efficient and economical constructions, and can be completed in a fast time without reducing the quality of construction and its main function. This is important to consider, given that floods and other natural disasters caused by human activities tend to increase in intensity and complexity, so that the losses incurred also continue to increase from year to year. Therefore, for each development project plan, its feasibility level should be calculated in advance, both economically, financially, and socially, so that the project is not only economically effective but also has a high value of benefits for the community.

For this purpose, we are trying to conduct a study on the feasibility of the project from the aspect of the benefit cost ratio (BCR), with the following stages of analysis.

II. Economic Valuation Methods

Theoretically, disaster loss assessment methods can be classified into:

2.1 Losses Without Projects

1) Direct Losses: that is losses calculated on the basis of direct physical damage due to flooding and standing water. Floods in *X-City* averaged 2 times per year, in addition to the average frequency per year, floods always inundate *X-City* every heavy rain, with the area affected by reaching approximately 1442 Ha, with an average inundation period 15.8 hours with an average height of 0.6m.

This condition has caused direct physical losses in the form of road damage of approximately 34,935 meters with an average width of 8 meters or approximately 279,480 M^2. While the number of buildings affected by the flood reached 12,692 units with an average building area of more than 70M^2. Thus the volume of buildings affected is approximately 888,440M^2, with an average damage rate estimated at 20%, thus the total cost of repairing the estimated market price for hotmix per M^2 with a thickness of 5 cm of IDR 75,000.-, the loss for damage the road reaches

IDR 20.96 billion, while damage to buildings by using an estimated NJOP price of IDR 2.5 million per M^2, the total loss from building damage is IDR 444.22 billion. So the total direct physical loss is estimated at around IDR 465.18 billion, as shown in Table 1.

2) Indirect Losses: the consequences that must be borne due to physical damage. Survey data recorded that there were approximately 59,188 families affected, so they had to bear the loss in the form of lost work opportunities on average 2 days each time flooding, as well as other losses in the form of increased costs of health care, maintenance of household equipment, and others. The non-direct loss is estimated at IDR 31.96 billion, consisting of a loss of income of 59,188 households for 2 days with an average income per day based on the per capita GRDP (Gross Demostic Regional Bruto) of *X-City* at IDR 70,000.- or as much as IDR 8.28 billion, and costs the average check and health care is IDR 100,000 per person, assuming an average family of 4 people, the loss is IDR 23.67 billion.

Therefore, the accumulation of direct and indirect losses which must be borne by the community is estimated at IDR 497,145,520,000, - as shown in Table 1, below:

Table 1
Losses without Projects

No	Description	Volume	Cost	Amount (RP)
I	**Direct Losses**			
	1. Building	888.440M^2(0,2)	Rp 2,5 mil/M^2	444.220.000.000,-
	2. Road	279.486 M^2	Rp 75.000	20.961.000.000,-
II	**Indirect Losses**			
	1.Lost Income	59.188 KK(2)	Rp 70.000/day	8.286.320.000,-
	2.Health Care	59.188(4)	Rp 100.000	23.675.200.000,-
III	**Total Loss**			497.145.520.000,-

2.2 Estimated Benefits

Before the feasibility analysis is carried out, it first needs to be examined and analyzed about the benefits, namely the added value both directly and indirectly from the construction of *X-City* drainage system. The benefit components of the development and operation of the integrated drainage system considered in the feasibility analysis are as follows: Reduction of flood frequency and inundation is estimated to be proportional to the project development stage, so that within that period the benefits increase linearly.

2.2.1 Analysis of Economic Benefits

An analysis of economic benefits is needed to measure the rate of return calculated among others based on the benefits of saving costs of repairs and maintenance of houses, savings in medical and health care costs, travel time and transportation costs, accident saving for precautions, and the development of the area caused by the existence of the system adequate city drainage.

The economic benefits in this analysis are explained by the reduced value of community losses as a positive impact of the construction of drainage projects. The benefit of kat with a sensory level is predicted to increase proportionally based on the stage of the project, namely Package I 2011 to 2013, the project sensitivity level is estimated at 0.4 of the total loss without the project. In Packages II and III, the project benefits increased with a sensitivity level of 0.5 and 0.75, respectively. The value of benefits can be calculated from the 4th year onwards.

2.2.2 Financial Benefits Analysis

While the analysis of financial benefits is the rate of return calculated based on the amount of money obtained by the community both households, farmers, and industry from potential revenues without flooding and standing water.

The benefit assessment is carried out according to two situations, namely for a scenario without a drains project (without a project) and with a drainage development project (with project).

Based on the data in Table 1, the total financial loss without a project is IDR 31.96 billion. So what is meant by financial benefits in this analysis is the reduction in financial losses after the project. If the project goes according to plan, the losses will be reduced proportionally based on the stage of work, which is accumulated shown in Table 1.

III. Feasibility Analysis Process

Comparison of costs and benefits is one of the instruments in determining the economic and financial viability of the construction and operation of public facilities, including the construction of *X-City* drainage system.
The feasibility analysis process is carried out in 3 stages, as follow:
(1) the process of estimating economic / financial costs (construction, operation, and maintenance costs).
(2) estimate the economic benefits and financial income of the project.
(3) conduct a feasibility analysis to find out a number of feasibility indicators, Net Present Value (NPV), and Benefits Cost Ratio (BCR).

Table 2
Comparison of Economic and Financial Feasibility

No	Aspect	Economy	Financial
1	Point Of View	Public	Private
2	Target	Efficiency	Profit
3	Criteria	NPV, dan BCR	IRR
4	Application	Government Project held by government or private for public business	Private Project held by private with profit oriented

3.1 Indicator of Eligibility

3.1.1 Net Present Value (NPV)

Net Present Value is the difference between the Present Value Benefit reduced by the Present Value Cost. The NPV results from a project that is said to be financially feasible are those that produce a positive NPV value. In this case all plans will be implemented if NPV> 0, or the above equation meets:
Net Present Value (NPV) = PVBenefit - PVCost > 0

That means that the construction of the terminal construction will provideprofit, where the positive benefit / cash flow will be greater than the cost / cash negative flow.

Benefit Cost Ratio is the ratio between Present Value Benefit divided by Present Value Cost. The BCR results of a project are said to be financially feasible if the BCR value is greater than 1. This value is done based on the current value, namely by comparing the difference in benefits with costs greater than zero and the difference in benefits and costs are smaller than zero.
General equation for This method is as follows:

$$B/C_{Nett} = \frac{\text{Present Value Nett Benefits}}{\text{Capital Cost}}$$

B/Cnet < 1, indicates poor investment. This matter illustrates that the benefits derived from building a drainage system are smaller than the investment spent.

The calculation of losses caused by flooding includes all losses that must be borne by all components of society (all members of the society), using market prices to describe the true value of losses as a direct impact, by first setting limits -the boundaries of areas assessed for economic losses carefully through the approach with and without disaster, not before and after disaster.

Besides that, in the context of efforts to reduce the level of loss and improve the socio-economic welfare of the people who so far have often suffered losses due to flooding, in making the drainage master plan, it is necessary to include efforts to reduce disaster risk in integrated development planning. Considering that integrated development planning is multisectoral, a multi-sector approach is needed in its planning, because the development of public utilities is directly correlated with the socio-economic activities of the community. Considering that *X-City* drainage system development plan is included in the category of investment development in projects aimed at efforts to improve the welfare of the community, in its implementation it is recommended to integrate disaster risk at each stage of the project.

3.2 Impact Analysis

Communities in residential areas are the largest part affected by flooding and inundation, because the feasibility of the project from the economic sector is very much determined how big the impact of the project is on the level of reduction in the burden that must be borne by the community between the current conditions without the project with the conditions that will come after project development.

3.2.1 Estimated Costs

In the implementation of the construction of urban drainage systems in *X-City* covering 8 districts. Construction construction, all proposed project components are expected to be carried out in 10 (ten) fiscal years, divided into three stages of construction construction, the first stage from 2011 to 2013 with an estimated cost of IDR 100,155 billion, the second phase of 2014-2016 is estimated to cost IDR 84,810 billion, while the third phase, which is 2017-2020, is budgeted at IDR 145,035 billion. So the total construction cost of the project component is estimated at IDR 330,000,000,000. With the details as shown in Table 3, below

Table 3
Estimated Construction Costs

No	ACTIVITY TYPE	COST (Rp)
1. 2. 3.	Package I Package II Package III	100.155.000.000,- 84.810.000.000,- 145.035.000.000,-
	Total PPn 10%	330.000.000.000,- 33.000.000.000,-
	Grand Total Three hundred sixty three billion rupiah	363.000.000.000,-

The proposed project financing schedule is divided according to the proposed project implementation schedule. However, the project financing schedule is planned for 10 (ten) fiscal years, and is divided into 3 packages.
The basic assumptions in planning a project financing schedule are:
Financial-economic conversion factor for construction is 0.90.
In calculating economic costs, the contractor's profit of 10% is not included so that the conversion value is equal to 0, the project administration is set at 5%, the average inflation rate per year is 5%
A tax of 10% is included only in financial costs and is not included in economic costs until the conversion value = 0.
Based on calculations, in Table 4 it can be seen that the total project financing for 10 (ten) fiscal years the economic value is
IDR 314,025,450,000, -, while based on financial costs, the amount is estimated to reach IDR 430,984,400,000. Financing plans and project scheduling both financially and economically in detail are presented in detail in Table 4.

3.2.2 Economic Analysis

The economic analysis carried out includes the calculation of NPV and BCR, using the following assumptions:
• 10% discount rate.
• The useful life of the project is 10 years.
• Construction time is 10 years.
The reduction in flood frequency and inundation is estimated to be proportional to the project development stage with the level of sensitivity of the project to the total loss estimated to increase proportionally to 0.4 in Phase I, 0.5 and 0.75, respectively.
Based on these assumptions, a calculation with estimated results is then made as shown in Table 4, below.

Table 4.
BCR Drainage Project

Year	Cost (C)	Benefit (B)	B-C
1	33,385,000,000.00		(33,385,000,000.00)
2	33,385,000,000.00		(33,385,000,000.00)
3	33,385,000,000.00		(33,385,000,000.00)
4	28,270,000,000.00	60,260,063,030.00	31,990,063,030.00
5	28,270,000,000.00	54,781,875,480.00	26,511,875,480.00
6	28,270,000,000.00	49,839,149,870.00	21,569,149,870.00
7	48,345,000,000.00	56,751,771,690.00	8,406,771,690.00
8	48,345,000,000.00	51,785,991,670.00	3,440,991,670.00
9	48,345,000,000.00	47,078,174,240.00	(1,266,825,760.00)
10	48,345,000,000.00	64,397,088,080.00	16,052,088,080.00
		58,625,650,940.00	58,625,650,940.00
		48,931,645,670.00	48,931,645,670.00
		44,547,089,610.00	44,547,089,610.00
Total	378,345,000,000.00	384,894,114,060.00	6,549,114,060.00
NPV			5,017,274,269.00
BCR			1.02

Based on the results of these calculations, it can be said that the planned construction of *X-City* drainage system has a good economic value with an NPV of IDR 5,017,274,269, and a benefit cost ratio (BCR = 1,045). Based on this analysis, the drainage project is economically feasible to be realized.

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