# Economic Feasibility Study on the Construction of the Bubon Port Pier, West Aceh Regency

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**Abstract.** The port of Kuala Bubon, as the maritime axis of the west-south part of Aceh, is one of the crossing ports to connect community activities in West Aceh Regency and its surroundings to Simeuleu Island. Every year, both the demand for goods and passenger departures are increasing every year. Currently, to facilitate logistics transportation and support crossing activities for passengers, goods or services between islands, it is planned to develop buildings and facilities at the Kuala Bubon Port. The purpose of this study is to determine the results of an economic feasibility study on the construction of a port pier so that later it can be seen the design drawings of the port pier and other appropriate facilities. This irrigati on development feasibility study uses the Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return IRR, and Break Event Point (BEP) methods. The data analysis in this study includes analysis of RAB (Expense Budget Plan) and analysis of cash flow (cash flow). This calculation includes the cost of capital which consists of direct costs and indirect costs. For cash flow analysis, NPV analysis is needed. If the NPV is positive, then the investment is feasible, if the NPVn is negative, then the investment is not feasible. Furthermore, the BCR analysis, if the BCR value 1, the IRR value the interest rate, BEP obtained when NPV = 0, then the project is said to be feasible to build. The results of the NPV value obtained were Rp. 391,744,370,503 or NPV > 0, BCR 37.65, IRR value 5.25% > rate of return (3.50%), and BEP occurred in the 2nd year on the 67th day which shows the payback period obtained is less than the economic life of the project, which is 30 years. Based on the results of the four cash flow analysis methods, it shows that the port development project is said to be economically feasible because it has met the feasibility requirements and the project can be implemented.

**Keywords:** Feasibility study · project · port · wharf · NPV · BCR · IRR

## 1 Introduction

The port is used as a berth for ships, anchoring, up and down passengers and/or loading and unloading of goods. At the port there are several shipping safety facilities and


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port support activities as well as a place for intra and intermodal transportation. A complete port contains several buildings such as piers, breakwaters, terminals, storage warehouses, shipping lanes, mooring equipment, and other facilities. The development of these buildings will be planned according to needs. In order to make the development of these facilities appropriate and avoid losses, a feasibility study is needed both physically and financially.

The importance of a feasibility study is to assess the investment feasibility of an ongoing project. After analyzing the project is feasible, then immediately made a design drawing. According (Kasmir & Jakraf, 2003) what is meant by a feasibility study is an activity to determine the feasibility of a project, whether it can be carried out or not so that the risk of loss can be avoided. This feasibility study is equipped with an analysis of Net Present Value (NPV), Benefit Cost Ratio (BCR), Internal Rate of Return (IRR), and Break Event Point (BEP).

Ferry transportation that connects the mainland and the island is an option. This is seen from the cost of transporting goods and the number of goods that can be transported. By ship, the goods are transported more and the cost is cheaper than air freight. The existence of this crossing is very important or immediately realized to achieve fair and equal transportation with the mainland.

In order for the maritime axis to be maintained, it can be realized through the construction of ports. Kuala Bubon Port, located in the village of Gampong Teungoh, is one of the connecting modes of sea transportation in West Aceh Regency. This port is located at coordinates 04º12′27″ - 04º12′35″ North Latitude, and 96º02′19″ - 96º02′25″ East Longitude, about 12 km from Meulaboh City. In an effort to maintain the maritime axis of the west-south area, Kuala Bubon Port is one of the crossing ports to connect community activities in West Aceh Regency and its surroundings to Simeuleu Island or the surrounding islands.

Kuala Bubon Port has been under construction since 2010 with a one-track shipping route, namely Kuala Bubon to Sinabang or vice versa. The crossing service uses KMP Teluk Sinabang. The capacity of the wharf is able to withstand a load of 750 GT, this wharf has a depth of 5 to 6 m. In addition to the ship's berth, the port of Kuala Bubon also has the potential to support the development of the Kuala Bubon beach tourism object with its beautiful scenery. This is shown by the many tourists who visit.

## 2 Theoretical Review

The Net Present Value (NPV) method is calculated by finding the net value (net) at the present time. Present is assumed to be the start of the calculation at the time of the evaluation or assessment. Evaluation in the initial year period (year 0) for cash flow investment analysis (Giatman, 2006). Analysis of the NPV value using the following equation:

$$\mathrm{NPV} = \mathrm{PWB} - \mathrm{PWC} \tag{1}$$

The formula for calculating PWB and PWC (Giatman, 2006):

$$\mathrm{PWB} = \sum_{t-1}^{n} \mathrm{CBt(FEB)t} \tag{2}$$

$$\text{PWC} = \sum_{t-1}^{n} \text{CCt(FEB)t} \tag{3}$$

Generally, the Benefit Cost Ratio (BCR) method is used in the early stages to assess investment planning. BCR is also used for additional estimates as a validation comparison against previous assessments with other methods. This method is very useful for evaluating government projects that have a direct impact on the community at large (public government projects), both positive and negative impacts. The focus of this method is to provide aspects of benefits (benefits) and aspects of costs (costs) borne as a result of the investment (Giatman, 2006).

In general, the BCR analysis method uses the following formula (Giatman, 2006):

$$BCR = \frac{\text{Benefit}}{Cost} \tag{4}$$

If the analysis is performed on present worth:

$$BCR = \frac{\text{PWB}}{PWC} \tag{5}$$

$$\begin{aligned} \text{PWB} &= \sum^{n} CBt(FBP) \\ \text{PWB} &= \text{Cb}(1 + \text{i}) \end{aligned} \tag{6}$$

$$\begin{aligned} \text{PWB} &= \sum^{n} Cct(FBP) \\ \text{PWC} &= \text{Cc}(Cc(1 + \text{i})) \end{aligned} \tag{7}$$

Internal Rate of Return (IRR) is a picture of the level of profit from a project or investment seen from the percentage of an interest rate (not bank interest) at a time when the NPV value is equal to zero (Kuswadi, 2007). IRR is an interest rate that illustrates that the benefits presented are equal to zero (Giatman, 2006). The equation to calculate the IRR value is as follows (Giatman, 2006):

$$\text{IRR} = \text{INPV0} + \frac{\text{NPV 0}}{\text{NPV0} + \text{NPV1}} (\text{INPV0} - \text{INPV1}) \tag{8}$$

Break Event Point (BEP) is the payback period or the break-even point where the expenditure and income are balanced (NPV = 0), so that at that time the investment did not experience a loss or profit. This method uses a trial and error technique of time/period until the cost of income = the cost of expenditure (Kuswadi, 2007). The formulation for BEP is (Sinaga & Saragih, 2013):

$$\frac{\text{n1} - \text{nx}}{\text{NPn1} - 0} = \frac{\text{n1} - \text{n0}}{\text{NPVn} - 1 - \text{NPVn} - 0} \tag{9}$$

## 3 Procedure of Experiment

The primary data in this study are data on port benefits and the mobility of crossing routes, both departures and arrivals for activities at the port, obtained from an interview

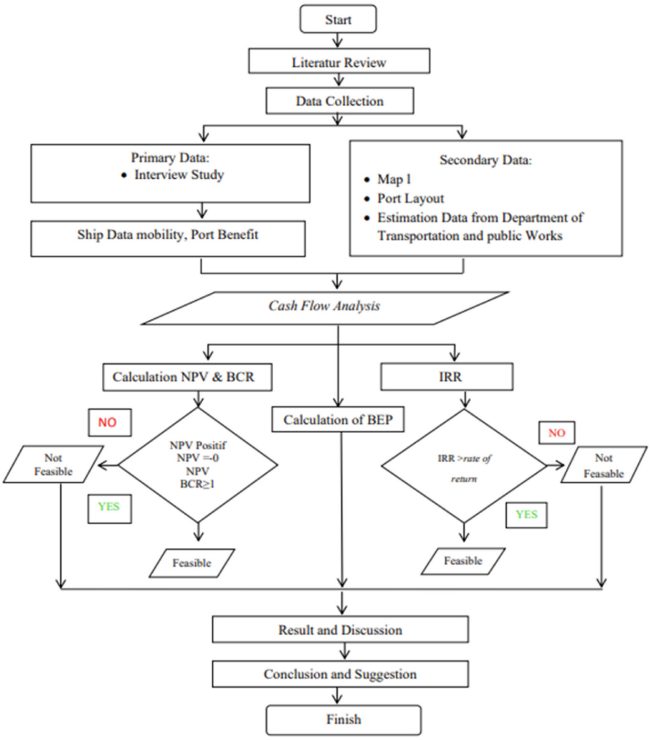


**Fig. 1.** Research flow chart

study with the Department of Transportation, the captain and the community as many as 2 people. The method in project evaluation in this development uses a comparison method between conditions before the project and after the project. Secondary data in this research is data obtained from the service or other agencies related to this research. The secondary data in this study are in the form of image data, the results of the calculation of the Budget Plan (RAB), and maps related to the location of the project being studied. For research stages can be seen in Fig. 1.

## 4 Result and Discussion

Basically when a project is going to be built the first thing that should be there is a cost or money. Cost is a form of expenditure made by a party, both individuals and companies to get more benefits from their actions that will produce a product or service. These costs lead to expenditures prior to the occurrence of the project, to obtain a feasibility level for the construction of port, including several types of costs, which consist of direct costs, indirect costs and annual costs.

1. Direct cost

   Direct costs are costs required for the construction of a project, such as the Budget Plan (RAB).

2. Indirect costs

   Indirect costs are costs associated with the overall project development process. Consulting service fees, namely costs for making designs starting from the initial study to planning and supervision costs during the construction period. This fee is taken 7% of direct costs.

   Consultant fee = 0.07 × 9,179,639,000
   = IDR 642,574,730

   Possible/unexpected costs of direct costs. These costs can be in the form of costs that are incurred but are uncertain, costs that are incurred but have not been seen, or costs that arise as a result of setting prices in the future (e.g. the possibility of price increases). This fee is taken 5% of direct costs.

   Unexpected cost
   = 0.05 × 9,179,639,000
   = IDR 458,981,950

   Based on the calculation of the two components of indirect costs, namely the cost of consulting services and possible costs, the total indirect costs obtained by adding up the two costs are IDR 642,574,730 + IDR 458,981,950, so the total indirect costs are IDR 1,101,556,680.
3. Annual fee

   Annual costs are costs that must be incurred during the life of the project. Calculation of this fee is taken 0.5% of direct costs.

   Operational and maintenance costs = 0.005 × 9,179,639,000
   = IDR 45,898,195
4. Overall expenses

   The total cost of expenditure or cash flow costs, calculated by adding up direct costs, indirect costs and annual costs. This total cost is the cash flow cost used for the calculation of cash flow analysis. Then the total cost of expenses is:

   Total costs
   = direct costs + indirect costs + annual costs
   = IDR 9,179,639,000 + IDR 1,101,556,680 + IDR 45,898,195
   = IDR 10,327.093,875
5. Benefits of having a project

   Based on these data, it can be concluded that the details of the benefits from the construction of port from the harvest and sale of land are as follows:
6. Port Operation Result: IDR 6,737,940,000/year
7. Sales of land: IDR 25,000,000/year

   The total cost of project benefits obtained from both types of income is by adding up the price of the number of ships and passengers= Rp. 6,737,940,000 + Rp. 25,000,000, then the result is Rp. 6,762,940,000. After the project, this value continues to increase because it is influenced by the interest rate factor of 3.50%.
8. Cash feasibility analysis

The following table presents a recapitulation table for calculating project life per year from cash flow analysis using the NPV, IRR, BEP and BCR methods.

Present Worth Benefit which has the meaning of calculating the value of profits while Present Worth Cost which means calculating the value of losses/expenditures. In

calculating the NPV, data is needed about the estimated investment costs, operational and maintenance costs and the estimated benefits of the planned project. The NPV value obtained is positive, which is Rp. 404,653,563. This value meets the requirements for the feasibility of a project, namely NPV > 0. For more details, see the calculation below:

NPV = PWB – PWC
NPV= (Cb (1 +i)$^{n}$ ) – (Cc (1+i)$^{n}$)
NPV= ((143.376.0282.000
(1+3,50%)$^{30}$)+
(25.000.000
(1+3,50%)$^{30}$)) –((9.179.639.000(1+3,50%)$^{1}$)+(45.898.195 (1+3,50%)$^{1}$))
NPV= 402,432,912,663 – 10,688,542,161
NPV= 391.744.370.503 > 0 **Feasible**

This is the calculation of BCR:
BCR= PWB/PWC
BCR= (Cb (1 +i)$^{n}$)/(Cc (1+i)$^{n}$)
BCR = ((143.376.0282.000
(1+3,50%)$^{30}$)+(25.000.000(1+3,50%)$^{30}$))/((9.179.639.000 1+3,50%)$^{1}$)+
(45.898.195
(1+3,50%)$^{1}$))
BCR= 402.427.645.721/10.688.542.160
BCR= 37,65 **> 1**
**Feasible**

If the calculation result is the same as the interest rate, it is said that the investment invested will return on investment, while if the IRR is less than the interest rate, then the investment is not feasible. To calculate the IRR value, the assumption is made between the 5.10% interest rate and the 5.20% interest rate, from the assumption of an interest rate of 3.50%. The IRR interest rate obtained is 5.25%, which shows the IRR is greater than the interest rate (i) which is 3.50%. This IRR value meets the requirements for the feasibility of a project, namely IRR > rate of return. For more details, see the following calculations:

If IRR with i = 5,10%
NPV = (Cb(1+i)n) – (CC(1+i)n)
NPV= (143.376.0282.000
(1+3,10%)30)+(25.000.000
(1+3,10%)30))-((9.179.639.000
(1+3,10%)1)+(45.898.195 (1+3,10%)1))
NPV= 637,615,395,908 –10.853.775.663

NPV= 626.761.620.245

If IRR with i = 5,20%
NPV= (Cb(1+i)n) – (CC(1+i)n)
NPV= ((143.376.0282.000
(1+3,20%)30)+(25.000.000
(1+3,20%)30)) –
((9.179.639.000
(1+3,20%)1)+(45.898.195(1+3,20%)1))
NPV= 656.068.986.959 – 10.864.102.757
NPV= 645.204.884.202

Then we get the value of IRR
$IRR = iNPV_0 + \frac{NPV0}{NPV0-NPV1}$
$(NPV_0 - NPV_1)$
$IRR = 5{,}20\% + \frac{645.204.884.202}{1.271.966.504.48}$ x (0,10%)
IRR= 5,25% > 3,50% **Feasible**

Based on the recapitulation table of the cash flow analysis calculation, it can be seen the costs from before the project until the project is completed. In the calculation prior to the existence of the project or year 0, capital costs and annual costs have not appeared because there has been no investment for irrigation canal development projects. While the cost of benefits has appeared in year 0 but there is no effect of interest rates and project life.

The total cost of benefits from the results of Port Operations and the selling price of land prior to the project was Rp 6,762,940,000. Then in the 1st year, the total cost of capital was Rp. 9,179,639,000. Annual costs, namely operational and maintenance costs, which were incurred in the 1st year, were Rp. 45,898,195.

The results of the cash flow analysis in the preparation of the Economic Feasibility Study on Port Development in Bubon Village, Samatiga District, West Aceh Regency used an approximate approach method. Based on the results obtained from the calculation of the RAB, the investment cost or capital cost in the Port development project issued is Rp. 9,179,639,000. As well as annual costs or operational and maintenance costs incurred amounting to Rp 45,898,195. Data on the benefits of port generate income costs or cash flow benefits of Rp. 6,762,940,000.

This is the sum of the number of ships and passengers. An investment project is said to be feasible if the NPV is positive, BCR > 1, IRR > rate of return, and BEP is obtained before the project's economic life. The calculation of cash flow analysis in this study uses an interest rate of (i) 3.50% and a period of (n) 30 years. The results of the NPV value obtained were Rp. 391,744,370,503 or NPV > 0, BCR 37.65, IRR value 5.25% > rate of return (3.50%), and BEP occurred in the 2nd year on the 67th day which shows the payback period obtained is less than the economic life of the project, which is 30 years. Based on the results of the four cash flow analysis methods, it shows that the port development project is said to be economically feasible because it has met

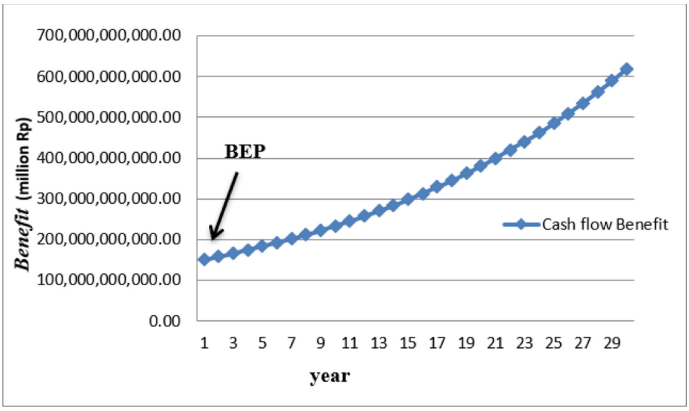


**Fig. 2.** The BEP Graph

the feasibility requirements and the project can be implemented. The graph of the Break Event Point (BEP) cash flow cost and cash flow benefit is obtained from the NPV results by adding up the income between the results of Port Operations.

The BEP graph in Fig. 2 shows that in the 1st year, the benefits obtained were Rp. 150,518,846,100, by adding up the results of the number of passengers and rice ships and the selling price of land. In the following year there was an increase/increase in the graph, this was due to an increase in the year. In the following year, namely in the 2nd year on the 67th day with the cash flow of Rp. 158,044,788,405 there was a break-even point or payback period which was marked by the meeting between the two graphs. It means that the BEP is balanced between expenditure and income (NPV = 0) so that at that time the investment does not experience a loss or profit. For expenses or cash flow costs, the graph is only straight or parallel and does not increase or decrease because the results of cash flow costs are obtained from the sum of direct costs, indirect costs and annual costs. Direct costs only occur when the initial capital of the project is implemented, while the annual costs will be the same every year until the end of the life of the project for the construction of the Port of Bubon Pier.

## 5 Conclusion

The results of the cash flow analysis in the preparation of the Economic Feasibility Study on Port Development in Bubon Village, Samatiga District, West Aceh Regency used an approximate approach method. Based on the results obtained from the calculation of the RAB, the investment cost or capital cost in the Port development project issued is Rp. 9,179,639,000. As well as annual costs or operational and maintenance costs incurred amounting to Rp 45,898,195. Data on the benefits of port generate income costs or cash flow benefits of Rp. 6,762,940,000. This is the sum of the number of ships and passengers. An investment project is said to be feasible if the NPV is positive, BCR $> 1$, IRR $>$ rate of return, and BEP is obtained before the project's economic life.

The calculation of cash flow analysis in this study uses an interest rate of (i) 3.50% and a period of (n) 30 years. The results of the NPV value obtained were Rp. 391,744,370,503 or NPV > 0, BCR 37.65%, IRR value 5.25% > rate of return (3.50%), and BEP occurred in the 2nd year on the 67th day which shows the payback period obtained is less than the economic life of the project, which is 30 years. Based on the results of the four cash flow analysis methods, it shows that the port development project is said to be economically feasible because it has met the feasibility requirements and the project can be implemented.

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## References

1. Amir, A., & Zakia. (2018). Optimasi Biaya Pelaksanaan Konstruksi Jalan Dengan Aplikasi Rekayasa Nilai (Value Engineering). Jurnal Teknik Sipil Dan Teknologi Konstruksi, 1(1), 72–83. https://doi.org/10.35308/jts-utu.v1i1.723
2. Giatman, M. (2006). Ekonomi Teknik. PT Raja Grafindo Persada.
3. Kasmir, & Jakraf. (2003). Studi Kelayakan Bisnis. Prenada Media Grup.
4. Kuswadi. (2007). Analisis Perekonomian Proyek. Andi Offset.
5. Sinaga, D. (2009). Studi Kelayakan Bisnis dalam Ekonomi Global : Teori dan Aplikasinya dalam Evaluasi Proyek. Mitra Wacana Media.
6. Sinaga, D., & Saragih, H. (2013). Studi Kelayakan Investasi Pada Proyek dan Bisnis Dalam Persfektif Iklim Investasi Perekonomian Global : Teori dan Aplikasinya dalam Menilai Investasi Modal Dalam Proyek dan Bisnis. Mitra Wacana Media.
7. Sudjarwardi. (2009). Pengantar Teknik Irigasi. Fakultas Teknik UGM.
8. Suharto, B. et al. (2001). Studi Evaluasi Finansial Pada Proyek Pemeliharaan Jaringan Irigasi. (Studi Kasus Pada Daerah Jaringan Irigasi Sumber Kedung Kandang Desa Kademangan Kecamatan Gondanglegi Kabupaten Malang). Jurnal Teknologi Pertanian, 2(1), 78–86.
9. Suryanto. (2011). Studi Kelayakan Ekonomi Teknik Pembangunan Embung. In Jurnal Teknik Sipil UBL (Vol. 2, Issue 1, pp. 88–97).
10. Syaeful Akbar, R., & Srihandayani, F. (2014). Analisis Dan Studi Kelayakan Pembangunan Kembali Pasar Turisari Kota Surakarta. September, 242–248.
11. Taufik, H., & Arianti, Y. (2013). Analisis Kelayakan Ekonomi Rumah Susun Sederhana Pekanbaru. Jurnal Sains Dan Teknologi, 12(1), 1–6. https://media.neliti.com/media/publications/200184-analisa-kelayakan-ekonomi-rumah-susun-se.pdf
12. Trikomara, R., & Fauzi, M. (n.d.). Analisis Kelayakan Ekonomi Pembangunan Waduk Keureuto di Kabupaten Aceh Utara Provinsi Aceh. Universitas Riau.
13. Zakia, Ikhsan, M., & Fadli, R. (2017). Studi kelayakan investasi pengembang perumahan (Studi Kasus Perumahan Griya Lapang Kecamatan Johan Pahlawan. Jurnal Teknik Sipil Dan Teknologi Konstruksi, 3(2), 44–54.
14. Amir, A., & Zakia. (2018). Optimasi Biaya Pelaksanaan Konstruksi Jalan Dengan Aplikasi Rekayasa Nilai (Value Engineering). Jurnal Teknik Sipil Dan Teknologi Konstruksi, 1(1), 72–83. https://doi.org/10.35308/jts-utu.v1i1.723