Vol 6 No 2 (July) pp. 374 – 392

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COST-BENEFIT ANALYSIS OF RIGID PAVEMENT ROAD CONSTRUCTION USING EXPONENTIAL, NPV, AND ERR METHODS (CASE STUDY: CIMANYING-JIPUT ROAD SECTION, PANDEGLANG, BANTEN)

Ficka Ruchiyat[1],Yudi Setio Prabowo[2]
[1,2]Universitas Serang Raya
fickaruhiyat@gmail.com

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ABSTRACT

This study aims to analyze the economic feasibility of rigid pavement road construction through a comprehensive cost-benefit analysis using Net Present Value (NPV), Economic Rate of Return (ERR), and exponential methods, with a case study on the Cimanying-Jiput road section in Pandeglang, Banten. This research employs a quantitative approach where data collection was conducted through field surveys to obtain primary data and documentation from relevant agencies to gather secondary data. The economic feasibility assessment uses NPV and ERR methods, where a project is considered economically feasible if it yields an NPV greater than zero and an ERR exceeding the Bank Indonesia discount rate of 4.60%. The calculation results show that the Net Present Value (NPV) is Rp. 5,687,857,786, and the Economic Rate of Return (ERR) is 15%. Both indicators demonstrate that the benefits generated exceed the costs incurred. Based on the cost-benefit analysis using NPV and ERR methods, the construction project for the Cimanying-Jiput road section is economically viable and recommended for implementation. The positive NPV and ERR values above the discount rate indicate that the project will generate substantial economic benefits for the community and transportation system in the region.

Keywords: Analysis, Benefit, Cost, Exponential, Feasibility, NPV, Pavement, Rigid, Road

1. INTRODUCTION

Construction of roads with rigid pavements has become a primary strategy in transportation infrastructure development in Indonesia due to its durability against traffic loads and long service life, despite high construction costs (Allen et al., 2025; Ghara et al., 2025; Xia et al., 2025). This technology is increasingly adopted in national and toll road projects to address tropical conditions that accelerate material degradation (Abebe et al., 2023; Gunawan et al., 2024; Tetteh et al., 2025). However, its economic efficiency compared to flexible pavement remains debated, necessitating in-depth studies on costs and benefits (Cortiços et al., 2024; Franciosi et al., 2024; Gedik, 2020).

The Cimanying–Jiput road section in Pandeglang, Banten holds significant strategic importance for local economic development. This 15-kilometer corridor serves as a vital transportation link connecting rural communities to urban centers, facilitating the movement of agricultural products, particularly rice, vegetables, and livestock from Pandeglang's fertile highlands to markets in Serang and Tangerang (Regional Development Planning Agency of Banten Province, 2023). The road also provides access to several tourist destinations in the region, including Curug

Cikondang and Mount Sangiang, contributing to the local tourism sector that employs over 2,000 residents directly and indirectly (Banten Tourism Office, 2024).

Currently, the existing flexible pavement road experiences severe rutting and cracking during the rainy season, causing frequent traffic disruptions and increasing vehicle operating costs by an estimated 25-30% (Pandeglang Public Works Department, 2023). The upgrading to rigid pavement is expected to reduce maintenance costs by up to 60% and improve travel time reliability, thereby enhancing regional connectivity and economic productivity.

Economic evaluations such as Net Present Value (NPV), Economic Rate of Return (ERR), and exponential methods are used to assess project feasibility (Hai et al., 2025; Kim & Kim, 2024; Pan et al., 2024). Life cycle cost analysis can also provide a more realistic overview of total costs (Adineh et al., 2025; Bru et al., 2025; Siwiec et al., 2025). Nonetheless, the integration of these three methods in rigid pavement road analysis is limited, especially for the Cimanying–Jiput corridor project.

Previous research by *Shokry et al* (2022) indicated that the Benefit-Cost Ratio (BCR) approach renders rigid pavement projects economically feasible, but does not incorporate exponential, NPV, and ERR methods simultaneously. Carmichael & Balatbat (2008) found that BCR and NPV are more accurate than the payback period method but have yet to consider ERR, which comprehensively accounts for social benefits.

This study aims to fill this gap by combining exponential, NPV, and ERR methods in the analysis of the Cimanying–Jiput road segment in Pandeglang, providing policy recommendations that are efficient and sustainable. The research formulates the problem around applying exponential, NPV, and ERR methods to evaluate the economic costs and benefits of constructing rigid pavement roads in the Cimanying–Jiput corridor, focusing on construction, maintenance, time value, and vehicle operational costs. The primary objective is to develop a data-driven cost-benefit analysis model to assess project feasibility and offer technical and investment policy recommendations.

This study contributes to the advancement of economic analysis methods responsive to nonlinear growth, supporting evidence-based policymaking and serving as a technical reference for project stakeholders. The scope is limited to the economic aspects of the Cimanying–Jiput project in Pandeglang, without directly addressing environmental impacts.

2. LITERATURE REVIEW

a. Basic Theory of Cost and Benefit Analysis

Cost and benefit analysis is an approach used to evaluate the economic feasibility of an infrastructure project by comparing the net benefits gained and the costs incurred over the project's lifespan (Abera et al., 2025; *Cost–Benefit Analysis of Unconventional Arterial Intersection Designs: Cairo as a Case Study*, 2022; Ding et al., 2024). A project is considered economically viable if the benefits outweigh the costs. In the context of rigid pavement construction, this analysis is particularly important because of the high initial construction costs, which are offset

Vol 6 No 2 (July) pp. 374 – 392
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by a long service life and lower maintenance costs compared to flexible pavements (Ghafoor et al., 2024; Punetha & Nimbalkar, 2025; Wang et al., 2025).

b. Economic Methods in Infrastructure Evaluation

Several methods are commonly used to assess the economic viability of infrastructure projects, such as Net Present Value (NPV), Economic Rate of Return (ERR), and exponential analysis (Ahsan Kabir et al., 2024; Nili et al., 2025; Pant & Pant, 2025). NPV calculates the present value of net cash flows throughout the project's life, while ERR measures the rate of economic return reflecting investment efficiency (Berrada, 2022; Remer & Nieto, 1995; Vieira et al., 2024). Exponential methods are used to project traffic growth over a specific period, providing a realistic estimate of future traffic volumes, which influence operational costs and time-based benefits (Du et al., 2025; Hur & Kim, 2025; Wu et al., 2025).

c. Previous Research

Several prior studies have examined the application of cost-benefit analysis for rigid pavement road development (Ghimire & Bheemasetti, 2025; Khan et al., 2025; Loi et al., 2025). Jamalimoghadam et al. (2024) concluded that rigid pavement projects are economically feasible based on the Benefit-Cost Ratio (BCR), although they have not yet integrated NPV and ERR methods. Essel et al. (2025) found that combining BCR and NPV provides a more accurate assessment of project feasibility compared to the payback period method, but ERR has not yet been considered as a primary parameter. Additionally, Xue et al. (2025) used life cycle cost analysis to evaluate maintenance costs and found that good maintenance planning can prevent expensive reconstruction costs in the future. These studies form the basis for this research to combine exponential, NPV, and ERR methods within a comprehensive analytical framework for more accurate and complete results (Chen et al., 2024).

d. Use of Exponential, NPV, and ERR Methods in This Study

The exponential method is used to project vehicle growth over the next 20 years, which will influence vehicle operating costs (BOK) and time savings. Next, NPV is used to calculate the present value of all benefits and costs throughout the project's lifespan. ERR is used to determine the project's economic return rate, considering the Bank Indonesia discount rate of 4.6%. If the NPV is positive and ERR exceeds this discount rate, the project is deemed economically feasible (Kim & Kim, 2024, 2024; Pan et al., 2024).

e. Components of Costs and Benefits in the Research

The cost components in this research include the expenses for road construction, which cover earthworks, pavement, and base layer, as well as road maintenance costs, including routine, periodic, and rehabilitative maintenance, calculated using the present value (PV) method. Meanwhile, the benefit components consist of time savings based on the number of delayed vehicles, assumptions about the number of people per vehicle, queueing time, and the Regent Minimum Wage (UMK) in Pandeglang. Additionally, benefits also include vehicle operational costs (BOK), calculated based on road conditions and average vehicle speeds during the construction period using the PCI 2007 method developed by PT Jasa Marga and LAPI-ITB (de la Hoz et al., 2025; Mbugua et al., 2025; Srivastava et al., 2025).

Vol 6 No 2 (July) pp. 374 – 392

DOI 10.51988/jtsc.v6i2.342

f. Relevance to Previous Studies and Contributions of This Research

This study fills the gap left by previous research by integrating three methods—exponential, NPV, and ERR—simultaneously in the cost-benefit analysis of constructing a rigid pavement road on the Cimanying–Jiput route in Pandeglang. The integration of these methods provides a more comprehensive perspective on traffic growth potential, the present value of investments, and the economic rate of return. The results of this research are expected to serve as a technical reference for project implementers and to inform sustainable policy recommendations for transportation infrastructure development in tropical regions such as Indonesia.

3. METODOLOGI PENELITIAN

a. Location and Time of the Research

This research was conducted on the Cimanying – Jiput road segment, Pandeglang Regency, Banten Province. This area was chosen as a case study because it is one of the strategic road segments in the development of transportation infrastructure in Banten that is currently being built or planned to be constructed with rigid pavement. The research was carried out starting from 2024, including the primary data collection through field surveys and secondary data collection from relevant agencies such as the Public Works and Spatial Planning Office (DPUPR) of Banten Province.

b. Research Design Stages

Vol 6 No 2 (July) pp. 374 – 392
©2025 Jurnal Teknik Sipil Cendekia
DOI 10.51988/jtsc.v6i2.342

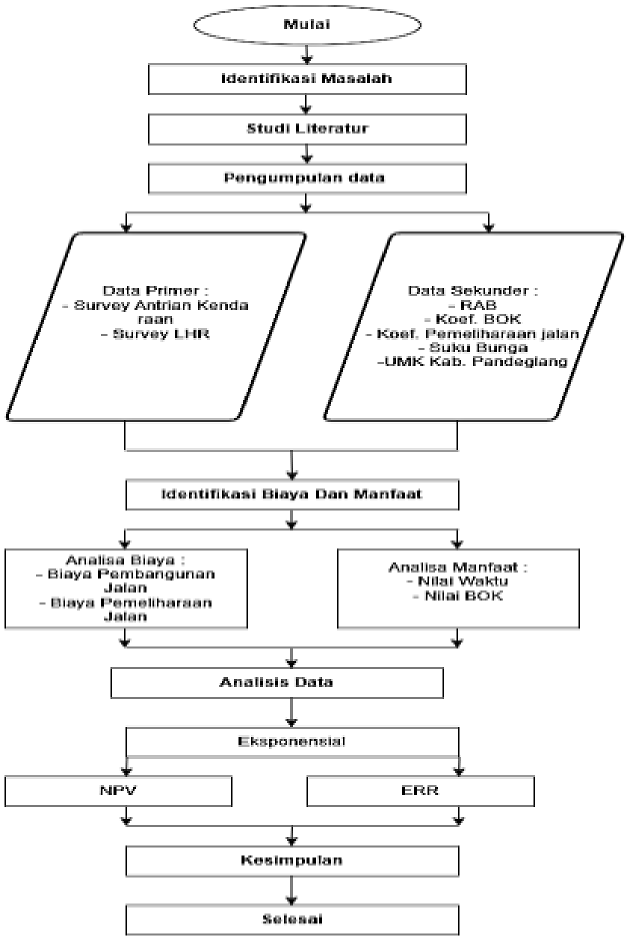

Figure 1. Research Flowchart

c. Data Collection Technique

In this study, the method used is a quantitative approach. To obtain the data, data collection techniques include conducting field surveys to gather primary data and surveys of relevant agencies to obtain secondary data. For primary data, the required data is vehicle queue surveys, due to the use of a single lane alternating from two directions as a result of road construction, and the traffic volume survey during the construction period. Meanwhile, the secondary data needed includes construction cost data, which consists of land work costs, pavement costs, and foundation layer costs. Additionally, data on BOK coefficient, road maintenance coefficient, interest rate, and the minimum wage (UMK) for Pandeglang Regency are also required.

d. Data Analysis Technique

This chapter includes a description of the research location, the timing of the research, a flowchart of the research process, an explanation of the research procedure, and the approach/method used in the study. Data analysis is performed

Vol 6 No 2 (July) pp. 374 – 392
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DOI 10.51988/jtsc.v6i2.342

through mathematical calculations based on the data obtained, whether from agencies, observations, or literature data.

In this study, the calculation methods used are Exponential, NPV, and ERR. The exponential method is used to calculate cost growth based on vehicle projections for the next 20 years. Next, NPV and ERR methods are used to assess the economic feasibility of road construction. Below are the calculation formulas for analyzing the data:

Exponential Calculation Formula:

$$Pn = po.e^{r.n} \tag{1}$$

Where:
Pn = number of vehicles in year n
Po = number of vehicles in the initial year
R = vehicle growth rate from the initial year to year n
n = number of years
e = Euler's number (2.718281828)

NPV Calculation Formula:

$$NPV = \sum \frac{Bt}{(1+r)}{}_t - Ct \tag{2}$$

Where:
Bt = benefits
Ct = cost
t = discount rate or interest rate period
r = investment period or discount rate

ERR Calculation Formula:

$$ERR = r_{1+} \left(\frac{NPV1}{NPV1-NPV2}\right) (r_2 - r_1) \tag{3}$$

Where:

r_1 = first discount rate with a positive NPV

r_2 = second discount rate with a negative NPV

NPV_1 = NPV at r_1

NPV_2 = NPV at r_2

To determine the cost-benefit analysis calculations derived from this study, several variables previously used in earlier research as references are employed, including:

1) Road Construction Costs

Vol 6 No 2 (July) pp. 374 – 392
©2025 Jurnal Teknik Sipil Cendekia
DOI 10.51988/jtsc.v6i2.342

Road infrastructure construction costs encompass all expenditures required for planning, building, and maintaining roads to enhance connectivity and the distribution of goods and services. (Saputri, R. M. 2019). Road construction costs contribute to regional economic growth and must be carefully planned to prevent budget wastage. (Mardiana, A., & Habu, A. 2021). In this study, the construction costs on the Cimanying - Jiput road segment consist of earthwork costs, pavement costs, and base layer costs.

2) Road Maintenance Costs

According to Faisal (2023) in the UIN Saizu Repository, road maintenance costs include expenses allocated to preserve the road condition to keep it functional and extend its service life. These costs are divided into routine maintenance, periodic maintenance, and rehabilitation. (Faisal, A. 2023). Road maintenance aims to prevent further damage and avoid higher reconstruction costs in the future. (Pradana, G. H., & Kriswardhana, W. 2020). In this study, to calculate road maintenance costs on the Ciamnying - Jiput road segment, the present value method formula is used. The calculation formula is as follows.

$$PV = \frac{C}{(1+r)}{}^{t} \quad (4)$$

Where:
PV = Present value of maintenance costs
C = Estimated road maintenance costs ((Road volume / m^3 × Road maintenance coefficient) × Unit price of concrete / m^3)
r = Discount rate
t = 1 (Year 1)

3) Time Savings

In the study by Wardoyo, D. U., & Fauziah, H. D. (2024), it is explained that in public infrastructure projects, the value of time is used to measure the long-term benefits of investments made by the government or private companies. (Wardoyo, D. U., & Fauziah, H. D. 2024). The value of time is obtained from an approach based on per capita income multiplied by the delay duration on the road and the volume of vehicles. (Renita & M. Zainal, 2022). The following is the formula for calculating time savings in the construction of the Cimanying - Jiput road:

$$Y = A \times B \times C \times D \quad (5)$$

Where:
A = Average number of vehicles delayed due to the use of a single lane alternation from two directions because of road construction (per day)
B = Assumption of the number of people per vehicle
C = Average queue time of vehicles due to the use of a single lane (minutes)
D = Minimum wage of Pandeglang Regency 2024 (per minute).

4) Vehicle Operating Costs (BOK)

According to Kurniadi (2020) in the Feasibility Study of Toll Road Investment,

Vol 6 No 2 (July) pp. 374 – 392
©2025 Jurnal Teknik Sipil Cendekia
DOI 10.51988/jtsc.v6i2.342

vehicle operating costs are highly influenced by road conditions, route length, and average vehicle speed within a transportation network. (Kurniadi, Y. 2020). Vehicle operating costs represent the total costs of vehicle usage, including fuel, maintenance, and depreciation during the operational period. (Nurrahmah, S. 2019). In this study, the BOK used is the non-toll BOK method PCI 2007, developed by PT. Jasa Marga and LAPI - ITB. Several indicators are used as the basis for calculating BOK for class I and II B vehicles, among others:

Table 1. BOK Indicators

No	Indicator	Group	Equation
1	Fuel consumption factor (Fbb)	Group I (Car)	$0{,}05693 \times S^2 - 6{,}42593 \times S + 269{,}18567$
	Fuel consumption factor (Fbb)	Group II A (bus)	$0{,}21692 \times S^2 - 24{,}1549 \times S + 954{,}78824$
	Fuel consumption factor (Fbb)	Group II B (truck)	$0{,}21557 \times S^2 - 24{,}17699 \times S + 947{,}80882$
2	Lubricant consumption factor (fmp)	Group I (Car)	$0{,}0037 \times S^2 - 0{,}04070 \times S + 2{,}20405$
	Lubricant consumption factor (fmp)	Group II A (bus)	$0{,}00209 \times S^2 - 0{,}24413 \times S + 13{,}29445$
	Lubricant consumption factor (fmp)	Group II B (truck)	$0{,}00186 \times S^2 - 0{,}22035 \times S + 12{,}06486$
3	Tire consumption factor (Fkb)	Group I (Car)	$0{,}0008848 \times S - 0{,}0045333$
	Tire consumption factor (Fkb)	Group II A (bus)	$0{,}0012356 \times S - 0{,}0065667$
	Tire consumption factor (Fkb)	Group II B (truck)	$0{,}0015553 \times S - 0{,}005933$
4	Spare parts cost factor (Fpc)	Group I (Car)	$0{,}0000064 \times S + 0{,}0005567$
	Spare parts cost factor (Fpc)	Group II A (bus)	$0{,}0000332 \times S + 0{,}00020891$
	Spare parts cost factor (Fpc)	Group II B (truck)	$0{,}0000191 \times S + 0{,}0015400$
5	Labor cost factor (Fpk)	Group I (Car)	$0{,}00362 \times S + 0{,}36267$
	Labor cost factor (Fpk)	Group II A (bus)	$0{,}02311 \times S + 1{,}97733$
	Labor cost factor (Fpk)	Group II B (truck)	$0{,}01511 \times S + 1{,}21200$
6	Depreciation factor (Fdp)	Group I (Car)	$1 / (2{,}5 \times S + 100)$
	Depreciation factor (Fdp)	Group II A (bus)	$1 / (9 \times S + 315)$
	Depreciation factor (Fdp)	Group II B	$1 / (6 \times S + 210)$

Vol 6 No 2 (July) pp. 374 – 392
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DOI 10.51988/jtsc.v6i2.342

		(truck)	
7	Capital interest factor (Fbm)	Group I (Car)	150 / (500 x S)
	Capital interest factor (Fbm)	Group II A (bus)	150 / (2571,42857 x S)
	Capital interest factor (Fbm)	Group II B (truck)	150 / (1714,28571 x S)
8	Insurance factor (Fas)	Group I (Car)	38 / (500 x S)
	Insurance factor (Fas)	Group II A (bus)	60 / (2571,42857 x S)
	Insurance factor (Fas)	Group II B (truck)	61 / (1714,28571 x S)
9	Overhead	Group II B (truck)	10% of the subtotal

No	Calculation Formula for Vehicle Operating Costs	
1	Fuel Component (Fbb)	(Fbb x Distance x Unit Price of Fuel) / 1000
2	Lubricant Consumption (Fmp)	(Fmp x Distance x Unit Price of Lubricant) / 1000
3	Tire Consumption (Fkb)	(Fkb x Distance x Unit Price of Tires) / 1000
4	Spare Parts Cost (Fpc)	(Fpc x Distance x Depreciated Vehicle Price) / 1000
5	Labor Cost (Fpk)	(Fpk x Distance x Mechanic Hourly Wage) / 1000
6	Depreciation (Fdp)	(Fdp x Distance x 0.5 x Depreciated Vehicle Price) / 1000
7	Capital Interest (Fbm)	(Fbm x Distance x 0.5 x Depreciated Vehicle Price) / 1000
8	Insurance (Fas)	(Fas x Distance x 0.5 x New Vehicle Price) / 1000

Source: PT. Jasa Marga and LAPI – ITB

Notes:

S = Speed (km/h)

The BOK (Vehicle Operating Cost) was calculated based on a vehicle speed of 20 km/h during road construction on the Cimanying–Jiput section.

4. ANALYSIS AND DISCUSSION

a. Road Construction Costs

Based on the calculation, the construction cost of the Cimanying–Jiput road section reaches Rp 4,669,540,000 for a 20-year service life. This figure is consistent

Vol 6 No 2 (July) pp. 374 – 392
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DOI 10.51988/jtsc.v6i2.342

with the standard cost allocation of rigid pavement construction in rural areas in Indonesia. According to [PUPR (2020)], average rigid pavement road construction costs range between Rp 4–5 billion per kilometer depending on terrain, materials, and labor. However, this study does not specify the road length, which is a critical variable when comparing cost efficiency with other road projects. A more rigorous comparison with unit costs (per km) from similar rural roads in Banten or West Java would strengthen the analysis.

Table 2. Construction Costs for Cimanying – Jiput Road Section in 2024

No	Road Location	Construction Cost
1	Cimanying - Jiput	Rp 4.669.540.000

Source: DPUPR Banten 2024

b. Road Maintenance Costs

The estimated annual maintenance cost is Rp 65,852,074, calculated using the present value method and a discount rate of 4.80%. This aligns with the recommendation in SNI 8457:2017 regarding cost estimation for concrete road maintenance. However, the assumed coefficient of 2% for concrete road maintenance appears relatively conservative. In [Siregar & Nugroho, 2022], the coefficient for rural rigid pavement maintenance was closer to 2.5–3% due to wear from heavy vehicles and climate impact. Thus, the study may underestimate future maintenance burdens, potentially affecting long-term feasibility.

Table 3. Road Maintenance Cost Data for Road Construction in 2024

No	Road Surface Area (m³)	Concrete Road Maintenance Coefficient (%)	Unit Price of Concrete Pavement FS 45 (Rp)	Discount Rate
1	1.868,40	0,02	Rp 1.846.846,85	4,80%

Source: Researcher 2024

The concept for calculating road maintenance costs for the Cimanying – Jiput road section is based on an approach using the present value method. The estimated maintenance cost is obtained through the formula: (Road volume / m³ × road maintenance coefficient × unit price of concrete / m³), then divided by the discount factor over one year. As a result, the annual road maintenance cost is Rp 65,852,074.

Table 4. Annual Road Maintenance Cost Results for Road Construction in 2024

No	Year (t)	(C)	Discount Factor **(1+r)^t**	Total
1	1	69.012.973,09	1,048	65.852.074

Source : Researcher 2025

Next, the road maintenance cost during the construction of the Cimanying – Jiput section was calculated using the exponential method. This involved projecting vehicle data for the next 20 years by calculating the maintenance cost plus the exponential method results from 2024 to 2044. The results are shown in the following table:

Table 5. Maintenance Cost Results for Road Construction from 2024 to 2044

Year	Road Maintenance Cost	Year	Road Maintenance Cost
2024	65.852.074	2035	65.963.075
2025	65.853.785	2036	65.983.194
2026	65.857.207	2037	66.004.989
2027	65.862.341	2038	66.028.461
2028	65.869.186	2039	66.053.610
2029	65.877.569	2040	66.080.435
2030	65.887.629	2041	66.108.937
2031	65.899.365	2042	66.139.115
2032	65.912.777	2043	66.170.970
2033	65.927.866	2044	66.204.502
2034	65.944.632	-	

Source : Researcher 2025

c. Time Savings Value

The projected annual time savings amount to Rp 835,689,617, based on reduced waiting time during construction. This assumes each delayed vehicle carries two people and waits 15 minutes—a reasonable assumption also applied in [Setyawan, 2020]. However, this model treats all vehicles and passengers equally, whereas in reality, freight vehicles and public transport may contribute disproportionately to economic loss or savings.

Table 6. Daily Time Savings Data During Road Construction in 2024

No	Number of Delayed Vehicles (units/day)	Assumed Number of People per Vehicle	Vehicle Waiting Time (minutes)	Pandeglang Regency Minimum Wage in 2024 (minutes)	Total Time Savings (per day)
1	292	2	15	Rp. 261,37	Rp. 2.289.560,59

Source: Researcher 2025

The conceptual design for time savings during the construction of the Cimanying – Jiput section involves delayed vehicles caused by queues, which result from the use of a single lane alternating for two directions. The time value savings

Vol 6 No 2 (July) pp. 374 – 392
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DOI 10.51988/jtsc.v6i2.342

are calculated based on the approach: number of delayed vehicles (per day) × assumed number of people per vehicle × average queue time × minimum wage in Pandeglang Regency (per minute) × number of days in a year. Thus, the annual time savings amount to Rp. 835,689,617.

Table 7. Annual Time Savings Result During Road Construction in 2024

No	Daily Time Savings	Number of Days in a Year (days)	Total
1	Rp. 2.289.560,59	365	Rp. 835.689.617

Source: Researcher 2025

Next, the time savings during the construction of the Cimanying – Jiput section were projected using the exponential method. This involved projecting vehicle data for the next 20 years by adding the time savings results to the exponential method outputs from 2024 to 2044. The results are shown in the following table:

Table 8. Time Savings in Road Construction from 2024 to 2044.

Year	Time Savings	Year	Time Savings
2024	835.689.617	2035	835.800.618
2025	835.691.328	2036	835.820.737
2026	835.694.751	2037	835.842.532
2027	835.699.884	2038	835.866.004
2028	835.706.729	2039	835.891.153
2029	835.715.112	2040	835.917.978
2030	835.725.172	2041	835.946.480
2031	835.736.908	2042	835.976.658
2032	835.750.320	2043	836.008.513
2033	835.765.410	2044	836.042.045
2034	835.782.175	-	

Source: Researcher 2025

d. Vehicle Operating Costs

The total VOC is calculated at Rp 22,752,008 per year, assuming an average speed of 20 km/h during construction. While the use of the BOK model is consistent with the Directorate General of Highways (Bina Marga) guidelines, the absence of a detailed vehicle classification (light vehicles, heavy trucks, motorcycles) limits the precision of this estimate. For instance, [Rizal & Suparno, 2020] highlighted that heavy trucks contribute over 60% of total VOC in rural construction zones but are more affected by road conditions.

Table 9. Vehicle Operating Cost Data During Road Construction in 2024

No	Total Bok Per Km	Total LHR in One Year
1	Rp. 13.975,43	1.628

Vol 6 No 2 (July) pp. 374 – 392
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Source: Researcher 2024

The vehicle operating cost (VOC) during the construction of the Cimanying – Jiput section is calculated based on the average speed of vehicles passing through the section during construction, multiplied by the variables in the BOK equation. According to field survey results on the Cimanying – Jiput section using random sampling, the average vehicle speed during construction is 20 km/hour. Therefore, the total BOK is obtained by multiplying the vehicle speed of 20 km/hour by the traffic volume (LHR) on the section over one year, resulting in Rp. 22,752,008.

Table 10. Annual Vehicle Operating Cost During Road Construction in 2024

No	Total Bok Per Km	Total LHR in One Year	Total
1	Rp. 13.975,43	1.628	22.752.008

Source: Researcher 2025

Furthermore, the vehicle operating cost during the construction of the Cimanying – Jiput section was projected using the exponential method. This involved projecting vehicle costs for the next 20 years by adding the results from the exponential method from 2024 to 2044. The results are shown in the following table:

Table 11. Vehicle Operating Cost Results During Road Construction from 2024 to 2044

Year	Vehicle Operating Cost (BOK)	Year	Vehicle Operating Cost (BOK)
2024	22.752.008	2035	22.863.009
2025	22.753.719	2036	22.883.128
2026	22.757.142	2037	22.904.923
2027	22.762.275	2038	22.928.395
2028	22.769.120	2039	22.953.544
2029	22.777.503	2040	22.980.369
2030	22.787.563	2041	23.008.871
2031	22.799.299	2042	23.039.050
2032	22.812.711	2043	23.070.905
2033	22.827.801	2044	23.104.436
2034	22.844.566	-	

Source: Researcher 2025

Based on the calculations above, it is found that a cost-benefit analysis needs to be conducted to assist policymakers in evaluating the economic feasibility of a project. Cost-benefit analysis is one of the approaches that can be used to assess investment viability or to make decisions (Raden & Khoirul, 2023). In this study, the approach used for the cost-benefit analysis includes Net Present Value (NPV) and Economic Rate of Return (ERR).

Vol 6 No 2 (July) pp. 374 – 392
©2025 Jurnal Teknik Sipil Cendekia
DOI 10.51988/jtsc.v6i2.342

The variables used to analyze the NPV and ERR methods in this research are: Road Construction Costs, Road Maintenance Costs, Time Savings, and Vehicle Operating Costs (VOC). The Road Construction Costs and Road Maintenance Costs are considered as costs (expenses) incurred. Meanwhile, the Time Savings and Vehicle Operating Costs (VOC) are considered as benefits (benefits) gained.

After conducting the analysis and projections from the years 2024 to 2044, or over 20 years, the NPV is obtained by multiplying the benefits variable by the discount factor and then subtracting the costs variable. To determine the ERR, the calculation involves dividing the positive NPV by the negative NPV, adding the result to the positive NPV, and then multiplying by the difference between the discount rates of the negative and positive NPV.

The following is a table of the cost-benefit analysis results for the construction of the Cimanying – Jiput road section, analyzed using NPV and ERR over 20 years:

Table 12. NPV Results for Road Construction from 2024 to 2044

Tahun	Cost		Benefit	
	Construction Cost (Billion IDR)	Road Maintenance Cost	Vehicle Operating Cost	Time Value
0	4.669.540.000	65.852.074	22.752.008	835.689.617
1	0	65.853.750	21.711.564	797.415.389
2	0	65.857.103	20.720.257	760.895.663
3	0	65.862.133	19.775.698	726.049.940
4	0	65.868.839	18.875.616	692.801.419
5	0	65.877.222	18.017.715	661.076.688
6	0	65.887.282	17.200.069	630.805.959
7	0	65.899.018	16.420.732	601.922.536
8	0	65.912.430	15.677.855	574.362.782
9	0	65.927.520	14.969.680	548.065.985
10	0	65.944.285	14.294.537	522.974.217
11	0	65.962.728	13.650.837	499.032.211
12	0	65.982.847	13.037.070	476.187.236
13	0	66.004.642	12.451.801	454.388.982
14	0	66.028.114	11.893.665	433.589.449
15	0	66.053.263	11.361.365	413.742.838
16	0	66.080.088	10.853.667	394.805.454
17	0	66.108.590	10.369.397	376.735.606
18	0	66.138.768	9.907.440	359.493.518
19	0	66.170.623	9.466.736	343.041.237
20	0	66.204.155	9.046.274	327.342.554
Cost		6.055.015.475		
Benefit		11.742.873.261		
NPV (Billion IDR)		5.687.857.786		

Vol 6 No 2 (July) pp. 374 – 392
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DOI 10.51988/jtsc.v6i2.342

Source: Researcher 2025

Table 13. ERR Results for Road Construction from 2024 to 2044

Bank Indonesia Discount Rate			4,80%		
No	r1	r2	Npv 1 (Positif)	Npv 2 (Negatif)	ERR
1	15%	16%	177.431.231	-106.350.583	15%

Source: Researcher 2025

Based on the above calculation results, it is known that the Net Present Value (NPV) for the construction of the Cimanying – Jiput road segment is Rp. 6,055,015,475 in costs. Meanwhile, the benefits generated amount to Rp. 11,742,873,261. Furthermore, the calculation of the Economic Rate of Return (ERR) shows a positive NPV of Rp. 177,431,231 with a discount rate of 15%, while the negative NPV is Rp. -106,350,583 with a discount rate of 16%.

The NPV result for the construction of the Cimanying – Jiput road segment is obtained by subtracting the costs from the benefits. Based on the calculations, the NPV for the project is Rp. 5,687,857,786. The ERR is calculated by adding the positive NPV discount rate to the result of dividing the positive NPV by the negative NPV, then multiplying by the difference between the negative and positive NPV discount rates. Based on these calculations, the ERR for the project is 15%.

A project is considered economically feasible if it yields an NPV greater than 1 and an ERR exceeding the Bank Indonesia discount rate of 4.60%. This indicates that the benefits outweigh the costs. According to the above calculations, the NPV is Rp. 5,687,857,786, and the ERR is 15%. Therefore, the construction project on the Cimanying – Jiput road segment in 2024 is expected to generate a profit of Rp. 5,687,857,786. It can be concluded that the road construction project on the Cimanying – Jiput segment is economically feasible to implement in 2024.

5. CONCLUSION AND RECOMMENDATIONS

Based on the analysis conducted, the operational vehicle cost savings (BOK) and time value savings significantly surpass the total construction and maintenance costs of the Cimanying–Jiput road segment. The resulting net benefit of Rp. 5,687,857,786 indicates that the road project is economically viable and provides a considerable return on investment. Given these findings, it is recommended that the Government of Pandeglang Regency proceed with the development of the Cimanying–Jiput road. The local government should also ensure effective planning, transparent budgeting, and consistent maintenance to preserve the long-term value of the infrastructure.

Furthermore, future researchers are encouraged to expand the scope of analysis by examining the social and economic impacts of the road development, such as improved access to essential services, regional economic growth, and community welfare. Comparative studies with similar road projects in other regions

Vol 6 No 2 (July) pp. 374 – 392
©2025 Jurnal Teknik Sipil Cendekia
DOI 10.51988/jtsc.v6i2.342

could also offer valuable insights to optimize future infrastructure planning and policy decisions.

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