Eduvest – Journal of Universal Studies
Volume 6 Number 7, July, 2026
p- ISSN 2775-3735- e-ISSN 2775-3727

Financial Feasibility and Strategic Benefit Assessment of the Coal Hauling Road and Jetty Project in Muara Pahu (Case Study: Bangun Group, Kalimantan, Indonesia)

Eddy Karlowee*, Gallang Perdhana Dalimunthe, Widhyawan Prawiraatmadja
Institut Teknologi Bandung, Indonesia
Email: eddy.karlowee@gmail.com*, gallang.dalimunthe@sbm-itb.ac.id, widhyawan@sbm-itb.ac.id

Keywords
Coal Hauling Road, Jetty Infrastructure, Financial Feasibility, Capital Budgeting, Cost-Benefit Analysis

ABSTRACT
Coal remains a significant energy source in global and regional economies, particularly in developing countries where reliable energy supply and industrial growth continue to depend on coal availability. However, increasing production capacity requires reliable logistics infrastructure to overcome transportation constraints and operational risks. The Bangun Group's Tabang Project in East Kalimantan has experienced challenges related to seasonal disruptions in river transportation, which may affect coal delivery continuity and future production expansion. This study aimed to evaluate the financial feasibility and strategic benefits of the Muara Pahu Coal Hauling Road (CHR) and jetty project as a long-term logistics infrastructure investment. A quantitative case study approach was applied using capital budgeting and cost–benefit analysis methods. The assessment utilized secondary data from company reports, project documentation, industry references, and financial assumptions, with evaluation indicators including Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI), Payback Period, Benefit–Cost Ratio (BCR), and sensitivity analysis. The results showed that the project generated substantial economic value, with a positive NPV, an IRR exceeding the required rate of return, and a BCR of 3.18, indicating that the project benefits significantly exceeded the investment costs. Sensitivity analysis confirmed the project's resilience under variations in transportation volume, tariffs, operating costs, and discount rates. Beyond financial performance, the project improved logistics reliability, reduced transportation disruption risks, supported production scalability, and strengthened strategic infrastructure control.

INTRODUCTION

Coal remains one of the key drivers of civilization's development from the beginning of the industrial era to the modern period. Despite its negative reputation regarding environmental sustainability, coal continues to play an important role as a major energy source, particularly in developing countries seeking to maintain energy security, support economic growth, and develop emerging markets.

Coal accounts for approximately one-quarter of global primary energy consumption (Igini, 2024) and continues to generate more than one-third of the world's electricity. In 2022, coal-fired electricity generation reached a record level of approximately 10,440 TWh, accounting for 36% of global electricity generation, compared with 35% in the previous year (IEA, 2023). These figures highlight the continued importance of coal in the global energy mix, particularly for baseload power generation and energy-intensive industries. This section

provides an overview of global and regional coal demand and production trends, emphasizes Asia's dominant role in the coal market, and discusses the contribution of coal to economic growth and energy security, along with the challenges and opportunities arising from the transition toward a lower-carbon energy system.

During 2024–2025, the global coal mining industry reached a critical stage, requiring a balance between continued demand from developing economies and increasing pressure from environmental regulations and renewable energy development.

Bangun Group is one of Indonesia's leading coal mining companies, contributing to domestic and international coal supply. Despite the global energy transition, coal remains a significant energy source in many Asian countries due to its affordability, availability, and capacity to support industrial activities and electricity generation. Coal demand continues to be driven by developing economies, including China, India, Vietnam, and the Philippines, where population growth and industrial expansion require reliable energy supplies.

To maintain competitiveness and long-term sustainability, Bangun Group has implemented various improvements in mining operations, environmental management, and logistics infrastructure (Nuswanto et al., 2024; Rosada, 2025). The company applies good mining practices, land rehabilitation programs, greenhouse gas emission monitoring, and advanced coal handling facilities. In addition to pursuing business growth, the company is committed to occupational safety, community development, and environmental stewardship to ensure that economic performance is aligned with long-term sustainability objectives (Ardiansyah, 2024; Epstein, 2018).

One of the company's most important assets is the Tabang Project in East Kalimantan, which contributes the largest share of Bangun Group's coal production. As the company targets an increase in production from approximately 50 million metric tons to 80 million metric tons in the coming years, improving the efficiency and reliability of its distribution network has become increasingly important. Achieving these production targets requires not only effective mining operations but also a robust logistics and supply chain system capable of supporting higher transportation volumes (Schaltegger & Wagner, 2017).

Currently, coal from the Tabang Project is transported through the Gunung Sari and Senyiur jetties, which rely heavily on river transportation routes. However, fluctuations in river water levels during both dry and rainy seasons frequently disrupt coal transportation activities. Low water levels restrict barge operations during dry periods, while excessive rainfall may cause flooding and navigation difficulties. These disruptions can result in shipment delays, increased operational costs, and challenges in achieving production and sales targets Mitigating transportation disruptions in a supply chain: a cost-effective strategy (Albertzeth et al., 2020; Paul et al., 2019).

To address these challenges, Bangun Group initiated the Muara Pahu Coal Hauling Road (CHR) and Jetty Project. The project involves the construction of a dedicated coal hauling road approximately 100 kilometers in length, connecting the mining area directly to the Muara Pahu Jetty on the Mahakam River. The Mahakam River provides deeper and more stable navigation conditions compared with the existing transportation routes, enabling more reliable coal delivery and reducing operational risks associated with seasonal river fluctuations (Kanike, 2023).

Despite its strategic advantages, the project requires substantial capital investment of nearly USD 500 million. Considering coal price volatility and increasing pressure from renewable energy development, assessing the project's ability to generate long-term economic value is essential. Therefore, this study evaluated the financial feasibility of the Muara Pahu Coal Hauling Road (CHR) and Jetty Project using capital budgeting techniques, including Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI), and Payback Period. The study also examined project sensitivity to key assumptions and its contribution to strengthening the long-term sustainability of Bangun Group's coal distribution system.

METHOD

This study evaluated the financial feasibility of Bangun Group's Muara Pahu Coal Hauling Road (CHR) and Jetty Project using a quantitative case study approach. The analysis focused on determining whether the project could generate sufficient financial and economic value through established financial evaluation methods. The assessment employed key indicators, including Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI), Payback Period, and Benefit–Cost Ratio (BCR). The research framework incorporated project costs, revenue projections, operational assumptions, and market conditions to evaluate the project's overall viability and strategic contribution.

The study utilized secondary data obtained from company reports, project documentation, financial statements, government publications, industry reports, and relevant academic literature. Data collection was conducted through document analysis and literature review, while key assumptions were developed based on historical market trends and industry benchmarks. The analysis applied a coal price assumption of USD 80 per metric ton and a discount rate of 10%. Additional scenarios were evaluated through sensitivity analysis to assess project performance under varying conditions.

Financial feasibility was assessed using Capital Budgeting, Discounted Cash Flow (DCF) analysis, Cost–Benefit Analysis (CBA), and sensitivity analysis. These methods were applied to estimate value creation, investment returns, and potential risks throughout the evaluation period. Although the study had limitations related to confidential company data, market uncertainty, and assumption-based modeling, the methodology provided a systematic basis for evaluating the long-term feasibility, sustainability, and strategic value of the Muara Pahu Coal Hauling Road (CHR) and Jetty Project.

RESULTS AND DISCUSSION

Cost Benefit Analysis (CBA)

After evaluating the financial feasibility of the Muara Pahu Coal Hauling Road and Jetty Project using capital budgeting indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI), and Payback Period, this study further assesses the project using the Cost Benefit Analysis (CBA) approach. The purpose of this analysis is to evaluate whether the overall benefits generated by the project exceed the total costs incurred throughout the project's lifecycle.

Unlike conventional capital budgeting analysis, which primarily focuses on the project's financial returns from the investor's perspective, Cost Benefit Analysis (CBA) provides a broader evaluation, considering not only direct financial benefits but also operational, strategic,

and economic advantages generated by infrastructure development. This approach is particularly relevant for large-scale logistics and infrastructure projects, where project value extends beyond direct monetary returns and contributes to operational reliability, distribution efficiency, and long-term business sustainability.

In the context of the Muara Pahu Coal Hauling Road and Jetty Project, the Cost Benefit Analysis (CBA) approach is crucial because the project is designed not only to generate financial returns, but also to reduce dependence on seasonal river transportation, improve coal distribution reliability, support production sustainability, and enhance operational flexibility for Bangun Group. Therefore, the project's benefits include both measurable financial gains and broader strategic operational advantages.

The Cost Benefit Analysis in this study combines quantitative and qualitative approaches. The quantitative analysis focuses on evaluating the relationship between project benefits and costs using indicators such as the Benefit Cost Ratio (BCR). Meanwhile, the qualitative analysis addresses broader operational and strategic benefits that are difficult to fully quantify in monetary terms, such as improved logistics reliability, reduced risk of transportation disruptions, and potential long-term infrastructure utilization.

The structure of the Cost Benefit Analysis section is organised as follows :

1. Benefit Cost Ratio (BCR)
2. Strategic and Operational Benefits
3. Overall Cost Benefit Assesment

Through this approach, this study aims to provide a more comprehensive evaluation of the Muara Pahu Coal Hauling Road and Jetty Project by assessing not only its financial attractiveness, but also its broader operational and strategic contributions to the long term sustainability of Bangun Group's coal distribution system.

1. Benefit Cost Ratio (BCR)

The Benefit Cost Ratio (BCR) is one of the quantitative indicator commonly used in Cost Benefit Analysis (CBA) to evaluate the economic feasibility of a project by comparing the present value of project benefits with the present value of project costs. The BCR reflects the amount of economic benefits generated for each unit of cost invested in the project. In infrastructure and logistics investment analysis, the BCR is useful for assessing whether the overall benefits generated by the project are sufficient to justify the investment and operational expenditures incurred throughout the project's life cycle.

A BCR value greater than 1 indicates that the project generates benefits that exceed its total costs and can therefore be considered economically viable. Conversely, a BCR value below 1 indicates that the project's costs exceed its expected benefits.

The BCR formula is expressed as follows:

$$\text{BCR} = \frac{\text{Present Value of Benefits (PVB)}}{\text{Present Value of Costs (PVC)}}$$

Table 1. Benefit Cost Ratio (BCR)

Year	Coal Volume Transported (MT)	Operating Cash Flow (USD)	Discount Factor (10%)	PV of Benefits (USD)	Capital Expenditure (USD)	PV of CAPEX (USD)	Free Cash Flow to the Firm (USD)	PV for FCFF (USD)
0	-	-	1.000	-	437,716,339	437,716,339	-437,716,339	-437,716,339
1	35,400,000	177,521,219	0.909	161,382,926	11,300,000	10,272,727	166,221,219	151,110,199
2	49,800,000	262,173,037	0.826	216,671,931	26,869,637	22,206,311	235,303,400	194,465,620
3	51,400,000	277,756,159	0.751	208,682,313	26,869,637	20,187,556	250,886,522	188,494,758
4	51,100,000	282,821,335	0.683	193,170,777	-	-	282,821,335	193,170,777
5	51,600,000	292,775,354	0.621	181,790,460	16,512,886	10,253,203	276,262,468	171,537,257
6	45,400,000	261,795,334	0.564	147,776,641	-	-	261,795,334	147,776,641
7	45,600,000	269,482,217	0.513	138,286,987	-	-	269,482,217	138,286,987
8	53,900,000	329,797,016	0.467	153,852,742	24,244,423	11,310,202	305,552,593	142,542,860
9	48,700,000	303,438,321	0.424	128,687,469	-	-	303,438,321	128,687,469
10	48,700,000	310,903,907	0.386	119,866,915	18,576,997	7,162,236	292,326,911	112,704,679
Total	481,600,000	2,768,463,899		1,650,169,163	562,089,918	519,108,575	2,206,373,981	1,131,060,588

As seen in Table 1, the present value of benefits is represented by the discounted Operating Cash Flow (OCF) generated from the project's transportation and jetty loading operations over the 10 year analysis period. The use of Operating Cash Flow reflects the project's operational economic benefits before deducting capital expenditures. Meanwhile, the present value of costs consists of all discounted capital expenditures incurred throughout the project's lifecycle, including initial infrastructure development investments and periodic capital expenditures for rehabilitation, upgrading, and major maintenance activities.

The present value calculation is performed using the project discount rate of 10%, which represents the Weighted Average Cost of Capital (WACC) applied in the Discounted Cash Flow (DCF) analysis.

Based on the project's discounted cash flow projections, table IV.7 showing the present value of the project's benefits is estimated at around USD 1.65 billion, while the present value of the project's costs is estimated at around USD 519.11 million.

Table 2. Benefit Cost Ratio (BCR) Summary Calculation

Description	Value (USD)
Present Value of Benefits (PVB)	1,650,169,163
Present Value of Costs (PVC)	519,108,575
Benefit Cost Ratio (BCR)	**3.18**

The BCR of approximately 3.18 indicates that the Muara Pahu Coal Hauling Road and Jetty Project is capable of generating economic benefits more than three times greater than the total investment costs incurred throughout the project lifecycle. This result indicates that the project provides substantial economic value relative to its capital requirements and can therefore be considered economically viable.

The strong BCR performance is primarily supported by stable operating cash flow, high infrastructure utilization, and the project's ability to improve logistics efficiency while mitigating the risk of transportation disruptions caused by seasonal river conditions. In addition, relatively manageable periodic capital expenditure requirements contribute positively to maintaining a favorable benefit-to-cost relationship throughout the operational period.

Furthermore, the positive difference between the present value of benefits and the present value of costs also confirms that the project generates significant net economic benefits throughout the analysis period. This result is consistent with the Net Present Value (NPV) analysis presented in the previous section, where the project generated a positive NPV of approximately USD 1.13 billion.

Therefore, based on the Benefit Cost Ratio (BCR) approach, the Muara Pahu Coal Hauling Road and Jetty Project can be considered economically feasible, financially attractive, and strategically beneficial to support the long term sustainability and operational reliability of Bangun Group's coal distribution system.

2. Strategic and Operational Benefits

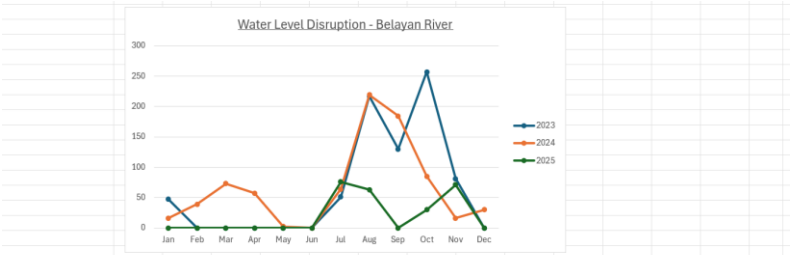
The Cost Benefit Analysis (CBA) of the Muara Pahu Coal Hauling Road and Jetty Project is not only limited to measurable financial returns, but also include broader strategic and operational benefits that support the long term sustainability of Bangun Group's coal distribution system. In addition to generating positive financial indicators through Capital Budgeting and Benefit Cost Ratio (BCR) analysis, the project is expected to improve logistics reliability, reduce the risk of operational disruptions, strengthen production continuity, and provide operational flexibility for future expansion. These benefits are particularly significant given the increasing production scale of the Tabang Project and its operational dependence on the river transportation system in East Kalimantan. The following subsections discuss the key strategic and operational benefits generated by the development of the Muara Pahu Coal Haul Road and Jetty infrastructure.

a. Reduction of Seasonal Transportation Disruption Risk

One of the most significant strategic benefits generated by the Muara Pahu Coal Haul Road and Jetty Project is the reduction in the risk of transportation disruptions caused by seasonal river conditions. Prior to the development of the Muara Pahu logistics route, coal transportation from the Tabang Project relied heavily on the Belayan and Kedang Kepala River systems, where barge navigation was significantly affected by water level fluctuations during the dry and rainy seasons.

Based on the actual Water Level Disruption Analysis data for the 2023–2025 period, operational disruptions caused by shallow river conditions and seasonal water level fluctuations contributed to a significant reduction in coal transportation effectiveness, with transportation losses reaching nearly 20% of the annual barge movement target on several occasions. These disruptions impacted the continuity of coal delivery operations to the Balikpapan Terminal and increased operational uncertainty in the logistics chain. The recurring low water level

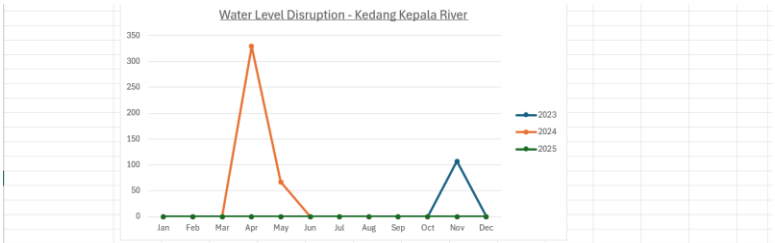
conditions limited barge depth capacity and reduced coal shipments during several critical operational periods.



Loss of Barges

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%
2023	47	0	0	0	0	0	51	217	130	257	81	0	783	18%
2024	16	39	73	57	2	0	64	219	184	85	16	30	785	18%
2025	0	0	0	0	0	0	76	63	0	30	71	0	240	5%

Figure 1. 2023-2025 Water Level Disruption (Gn.Sari Terminal)
(Source : Author)



Loss of Barges

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	%
2023	0	0	0	0	0	0	0	0	0	0	107	0	107	1%
2024	0	0	0	329	67	0	0	0	0	0	0	0	396	5%
2025	0	0	0	0	0	0	0	0	0	0	0	0	0	0%

Figure 2. 2023-2025 Water Level Disruption (Senyiur Terminal)
(Source : Author)

The construction of the 100 km Coal Hauling Road directly connected to the Muara Pahu Jetty on the Mahakam River strategically intended to mitigate this transportation constraint. Compared to the tributary river system previously utilized, the Mahakam River offers relatively deeper and more stable navigation conditions, allowing for more reliable barge transportation throughout the year. Therefore, this infrastructure reduces operational dependence on shallow river conditions and improve the resilience of the coal distribution system from seasonal operational disruptions.

b. Improvement of Logistics Reliability and Distribution Continuity

The development of the Muara Pahu Coal Hauling Road and Jetty infrastructure also significantly contributes to improving logistics reliability and distribution continuity within the Company's coal transportation system. In large scale coal mining operations, continuity of loading and transportation activities is crucial as disruptions in the logistics chain can directly impact delivery schedules, operational efficiency, and coal delivery performance to sales points at the Balikpapan Terminal.

Currently, the Tabang Project relies on two primary distribution channels through the Gunung Sari Jetty on the Belayan River and the Senyiur Jetty on the Kedang Kepala River. The Gunung Sari Jetty operates with a loading capacity of approximately 2,000 metric tons per hour and is capable of handling barges up to approximately 2,500 DWT (Deadweight

Tonnage). Meanwhile, the Senyiur Jetty operates on a much larger scale, with a loading capacity of approximately 12,000 metric tons per hour and the capability to handle barges up to approximately 8,000 DWT (320-foot class barges). These two jetty facilities currently serve as the main coal distribution channels supporting transportation activities from the Tabang mining area to the downstream logistics network.

The construction of the Muara Pahu Jetty on the Mahakam River is strategically designed to further strengthen the Company's logistics reliability and transportation flexibility. Based on the project development plan, the Muara Pahu Jetty is designed with operational specifications equivalent to or exceeding those of the existing Senyiur Jetty, with a loading capacity of approximately 12,000 metric tons per hour and the ability to accommodate larger barges up to approximately 9,800 DWT (320-foot class). Therefore, this additional logistics infrastructure expands the Company's transportation capacity while increasing flexibility in coal shipment distribution.

In addition to greater barge accommodation capacity, Muara Pahu Jetty is also planned to operate with four active barge loaders, compared to the three currently operating at Senyiur Jetty. This additional loading infrastructure is operationally important as it allows loading activities to continue more efficiently during barge changeovers and rotations. The availability of four barge loaders at Muara Pahu is expected to reduce operational idle time, minimize loading disruptions, and improve overall loading continuity throughout the logistics chain.

Overall, the development of the Muara Pahu logistics corridor enhances the operational reliability of the Company's coal transportation system by increasing loading flexibility, strengthening distribution continuity, reducing operational constraints, and supporting more stable delivery scheduling activities. The integration of the Coal Hauling Road and additional loading jetty infrastructure provides important long term operational benefits to maintain efficient and sustainable coal distribution operations. This development also aligns with the Company's strategic efforts to strengthen operational reliability and maintain stable coal distribution performance in line with future production growth targets.

c. Support for Long Term Production Scalability

One of the key strategic benefits of the Muara Pahu Coal Hauling Road and Jetty Project is its ability to support the long term scalability of Bangun Group's coal production and distribution operations. As coal production continues to increase, the availability of reliable logistics infrastructure is crucial to ensuring that production growth can be efficiently transported and delivered to customers without creating transportation bottlenecks.

Table 3. Coal Production of Company's Project

Project Name	**2021**	**2022**	**2023**	**2024**	**2025**
GBP	-	-	-	0.3	0.5
WBM	1.3	1.3	2.0	2.4	1.9
PIK	1.1	1.0	1.2	1.5	2.3
TSA/FKP	3.1	2.6	2.7	2.2	0.8
Tabang Project	32.1	34.0	43.8	50.5	62.5
TOTAL	**37.6**	**38.9**	**49.7**	**56.9**	**68.0**

(Source : Company's website)

The Company's production performance over the last several years has demonstrated a strong and consistent growth trend. Total coal production increased from 37.6 million metric tons (MT) in 2021 to 68.0 million MT in 2025, representing an increase of approximately 81% over the five year period. The most significant contribution to this growth comes from the Tabang Project, which increased its production from 32.1 million MT in 2021 to 62.5 million MT in 2025. As a result, the Tabang Project contributed approximately 92% of the Group's total production in 2025, highlighting its strategic importance within the Company's operational portfolio.

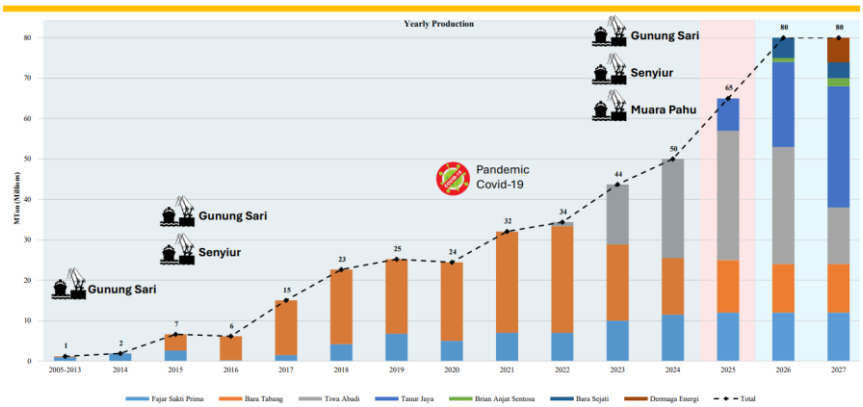


Figure 3. Coal Production Year to Year (Historical and Future Target)
(Source : Company's website)

The achievement of 68.0 million MT production in 2025 also exceeds the Company's initial production target and represents the highest annual production volume in the Group's history. This achievement demonstrates the Company's capability to continue expanding production capacity and executing its operational growth strategy despite challenging market conditions. Furthermore, the Company has set a long term production target of approximately 80 million MT per year, indicating a continued expansion plan for the coming years.

Under this growth environment, logistics infrastructure becomes increasingly important to ensure that production capacity can be translated into actual sales and revenue generation. While mining production may continue to increase, limitations in transportation and loading infrastructure can create operational bottlenecks that limit the Company's ability to fully realize its production potential. Therefore, the development of the Muara Pahu Coal Hauling Road and Jetty Project provides additional logistics capacity to support future production expansion while reducing dependence on the existing transportation corridors.

d. Strategic Infrastructure Control and Operational Flexibility

One of the most significant long term strategic benefits generated by the Muara Pahu Coal Hauling Road and Jetty Project is the enhancement of infrastructure control and operational flexibility across the Company's coal distribution network. Beyond its role in supporting transportation activities, the project serves as a strategic logistics asset that strengthens the Company's ability to manage coal distribution operations more effectively and efficiently. In large scale mining operations, the availability and control of logistics infrastructure are critical because transportation performance directly impacts production

continuity, delivery reliability, and overall business competitiveness (Abubakar et al., 2025; Bayoumi et al., 2021; Onah et al., 2026).

Prior to the development of the Muara Pahu logistics corridor, the Company's coal transportation activities primarily relied on two distribution channels that is the Gunung Sari Jetty located on the Belayan River and the Senyiur Jetty located on the Kedang Kepala River. While both facilities have successfully supported the Company's production growth over the years, reliance on only two transportation corridors creates concentration risks, particularly when operational disruptions occur due to seasonal river conditions, maintenance activities, or capacity constraints. The addition of the Muara Pahu Coal Hauling Road and Jetty creates a third strategic distribution channel directly connected to the Mahakam River, significantly strengthening the resilience of the Company's overall logistics network.

The existence of three major distribution corridors provides greater operational flexibility in managing transportation activities and allocating coal shipments. Under various operational conditions, coal volumes can be distributed between Gunung Sari, Senyiur, and Muara Pahu based on transportation capacity, river conditions, loading schedules, and operational priorities. This flexibility allows the Company to optimize logistics performance while reducing dependence on a single transportation route. With this plan, the Company can respond more effectively to operational disruptions and maintain stable coal delivery performance throughout the year.

The strategic importance of Muara Pahu is further strengthened by its operational specifications. The jetty is designed with a loading capacity comparable to the existing Senyiur Jetty, approximately 12,000 metric tons per hour, while also being able to accommodate larger barges of up to approximately 9,800 DWT. In addition, the planned operation of four active barge loading positions, compared to the three currently available at Senyiur, provides additional flexibility in managing barge rotations and loading schedules. This capability improves the Company's ability to handle higher transportation volumes and maintain continuous loading operations during periods of increased production activity (Yao et al., 2022).

From a strategic management perspective, ownership and control of logistics infrastructure provides important long term advantages for the Company. Unlike reliance on third party transportation assets, internally controlled infrastructure allows for greater flexibility in capacity planning, operational scheduling, maintenance management, and future expansion initiatives (Sinha et al., 2017). The development of the Muara Pahu logistics corridor therefore not only addresses current transportation needs but also builds a stronger foundation for future operational growth and supply chain management (Lee & Shen, 2020; Notteboom & Neyens, 2017).

Furthermore, this project enhances the Company's capability to support long term business sustainability by improving the reliability and adaptability of its logistics system. As production volumes continue to grow and operational requirements become more complex, the availability of multiple transportation corridors and loading facilities provides a greater strategic options for maintaining efficient coal distribution. This flexibility becomes particularly valuable in an industry where transportation performance plays a critical role in achieving production targets and fulfilling delivery commitments to customers (Ivanov et al., 2018).

Overall, the Muara Pahu Coal Hauling Road and Jetty Project strengthens Bangun Group's strategic control over its coal distribution network by enhancing logistics diversification, operational flexibility, and infrastructure resilience. This project not only supports current operational requirements but also enhances the Company's ability to adapt to future business growth, market conditions, and operational challenges, thereby creating sustainable long term strategic value beyond its direct financial returns.

e. Potential Third Party Utilization Opportunity

In addition to supporting the Company's internal coal transportation needs, the Muara Pahu Coal Hauling Road and Jetty Project also creates opportunities for future third party infrastructure utilization. The strategic location of the Muara Pahu logistics corridor along the Mahakam River, combined with substantial transportation and loading capacity, provides the potential for the infrastructure to serve external mining operators located within surrounding concession areas. As coal production activity continues to expand throughout East Kalimantan, the demand for reliable coal transportation and loading infrastructure is expected to remain a critical operational requirement for mining companies operating in the region.

The Muara Pahu jetty is designed with a loading capacity of approximately 12,000 metric tons per hour and the capability to accommodate barges up to approximately 9,800 DWT. Combined with the 100 km Coal Hauling Road connecting the Tabang mining area to the Mahakam River transportation corridor, the infrastructure provides a logistics platform capable of supporting coal transportation and loading services for external users through commercial transportation service agreements, coal loading arrangements, or other infrastructure sharing schemes.

To illustrate the potential economic value of third party utilization, a five-year illustrative scenario was developed assuming a third party transportation volume of 16 million metric tons annually, equivalent to approximately 20% of the company's future production target of 80 million metric tons per year. The coal transportation and loading rates applied in this scenario are based on the same benchmark rates used in the project's base-case revenue projections, thus maintaining consistency with the financial assumptions applied throughout this study.

Table 4. Third-Party Utilization Illustrative Scenario

CHR Tariff (rate): 0.03 USD/Mt/Km
Jetty Tariff (rate): 5.46 USD/Mt
3rd Party Quota: 16,000,000 Mt

Year	Coal Volume Transported (MT)	Distance (km)	Transport/Logistic Revenue (USD)	Coal Processing and Loading (USD)	Total Revenue (USD)
1	16,000,000	90	36,630,000	87,345,000	123,975,000
2	16,000,000	90	36,630,000	87,345,000	123,975,000
3	16,000,000	90	36,630,000	87,345,000	123,975,000
4	16,000,000	90	36,630,000	87,345,000	123,975,000
5	16,000,000	90	36,630,000	87,345,000	123,975,000
Total	**80,000,000**	**90**	**183,150,000**	**436,725,000**	**619,875,000**

Based on the illustrative scenario presented in Table 4, third-party utilization of approximately 16 million metric tons annually could generate additional revenue from coal transportation and loading of approximately USD 123.98 million per year. It can be seen that

over a five-year utilization period, the cumulative potential revenue could reach approximately USD 619.88 million, consisting of USD 183.15 million from coal road transportation services and USD 436.73 million from coal loading services at Muara Pahu Jetty.

The significance of this potential revenue demonstrates the strategic value of the Muara Pahu infrastructure beyond its primary function of supporting Bangun Group's internal coal transportation activities. Furthermore, because the majority of infrastructure investment has been made within the base project configuration, future third-party utilization could improve overall asset utilization efficiency and generate additional revenue without requiring a proportional increase in capital investment. Consequently, third party utilization could improve the infrastructure's long term economic performance while accelerating investment recovery.

However it should be noted that in this illustrated third party utilization scenario, no Discounted Cash Flow (DCF) analysis, Net Present Value (NPV) calculation, Internal Rate of Return (IRR) assessment, Return on Investment (ROI) analysis, Payback Period calculation, or Benefit Cost Ratio (BCR) evaluation were incorporated into the project's base case financial model. Therefore, all financial feasibility results presented in the previous section remain conservative and are based solely on the Company's internal coal transportation volume projections.

While the realization of third party utilization will depend on future commercial agreements, market demand, infrastructure availability, and operational considerations, the existence of this opportunity further strengthens the long term strategic value of the Muara Pahu Coal Hauling Road and Jetty Project. In addition to supporting Bangun Group's operational needs, this infrastructure has the potential to develop into a regional logistics asset capable of generating additional revenue streams and creating further economic value in the future.

3. Overall Cost Benefit Assessment

The Cost Benefit Analysis (CBA) conducted in this study demonstrates that the Muara Pahu Coal Hauling Road and Jetty Project provides substantial economic, operational, and strategic value for Bangun Group. From a quantitative perspective, the project generated a Benefit Cost Ratio (BCR) of 3.18, indicating that the present value of the project's benefits is more than three times greater than the present value of the project's costs. This result confirms that the project is economically viable and capable of generating significant value over its operational life. Furthermore, the positive Net Present Value (NPV), attractive Internal Rate of Return (IRR), high Return on Investment (ROI), and relatively short Payback Period identified in the Capital Budgeting analysis further strengthen the project's overall financial attractiveness.

Beyond the measurable financial benefits, the project also generates important strategic and operational advantages that contribute to the long term sustainability of the Company's coal transportation network. The development of the Muara Pahu logistics corridor reduces the risk of transportation disruptions associated with seasonal river conditions, improves logistics reliability and distribution continuity, supports future production growth targets, and strengthens operational flexibility through transportation route diversification. The addition of a third major distribution corridor directly connected to the Mahakam River also enhances the Company's ability to manage transportation capacity more efficiently while reducing dependence on existing logistics infrastructure.

The project further creates opportunities for future value creation through potential third party utilization of the Coal Hauling Road and Jetty facilities. While these opportunities were not included in the base case financial analysis, the illustrative scenarios developed in this study demonstrate that additional coal transportation and loading services for external users could generate significant additional revenue and improve overall infrastructure utilization efficiency. These potential benefits strengthens the long term strategic value of the investment beyond the benefits currently reflected in the financial feasibility assessment.

Overall, the findings of the Cost Benefit Analysis indicate that the Muara Pahu Coal Hauling Road and Jetty Project should not be viewed solely as a transportation infrastructure investment, but rather as a strategic logistics asset that supports operational resilience, production scalability, and long-term business sustainability. The combination of strong economic returns, improved logistics performance, enhanced infrastructure control, and future commercial opportunities demonstrates that the project creates substantial value for Bangun Group and provides a strong foundation to support the Company's long term growth strategy.

Sensitivity Analysis

The Capital Budgeting and Cost Benefit Analysis results presented in the previous section indicate that the Muara Pahu Coal Hauling Road and Jetty Project is financially feasible and economically beneficial under the base case assumptions adopted in this study. The project generates a positive Net Present Value (NPV), an Internal Rate of Return (IRR) that significantly exceeds the required rate of return, a high Return on Investment (ROI), a relatively short Payback Period, and a Benefit Cost Ratio (BCR) greater than one. These results collectively demonstrate the project's ability to create substantial value for Bangun Group.

However, investment decisions are inherently exposed to uncertainty arising from changes in operational and financial conditions over time. Variables such as coal transported volumes, hauling and loading rates, operating costs, and discount rates can fluctuate due to market conditions, operational performance, economic developments, and business circumstances. Changes in these variables may affect future cash flows and ultimately the overall financial feasibility of the project.

Therefore, a sensitivity analysis is conducted to evaluate the project's resilience under different scenarios and to identify which variables have the greatest impact on the project's value. This analysis examines the effect of changes in key assumptions on the project's Net Present Value (NPV), which serves as the primary indicator of financial attractiveness in this study.

The sensitivity analysis focuses on four key variables considered most relevant to the Muara Pahu Coal Hauling Road and Jetty Project : coal transport volume, coal hauling and loading rates, operating costs, and the discount rate. Each variable is tested independently by applying reasonable positive and negative variations while maintaining other assumptions constant. The results provide an indication of the project's resilience under changing business conditions and assist in identifying the key factors that may influence future project performance.

Sensitivity Analysis Framework

Sensitivity analysis is conducted to evaluate the robustness of the Muara Pahu Coal Hauling Road and Jetty Project under various operational and financial conditions. Although the results of the Capital Budgeting and Cost Benefit Analysis indicate that the project is

financially feasible and economically beneficial, the project's future performance remains subject to uncertainties arising from changes in key assumptions used in the financial model.

The purpose of sensitivity analysis is to identify the variables that have the greatest influence on project value and to assess the extent to which changes in those variables could affect the project's financial feasibility. By evaluating alternative scenarios, management can better understand the potential risks and opportunities associated with future project implementation.

In this study, sensitivity testing focuses on four key variables considered most relevant to the operational characteristics of the Coal Hauling Road and Jetty Project that is, coal transport volume, coal hauling and loading rates, operational costs, and the discount rates. These variables were selected because they directly influence project revenue generation, operational cash flows, and the project's discounted value.

Unlike conventional mining project evaluations, which typically use coal selling price as a sensitivity variable, this study focuses on coal transportation and loading infrastructure services. Therefore, project revenue is primarily driven by the volume of coal transported and service rates, rather than the selling price of the coal itself. The impact of coal price fluctuations is assumed to be reflected indirectly through changes in production and transportation volumes. Consequently, coal transportation volume is considered a more appropriate variable for evaluating project sensitivity.

Impact of Coal Volume Changes

The sensitivity analysis was conducted to evaluate the impact of changes in coal hauling and loading volumes on the financial feasibility of the Muara Pahu Coal Hauling Road and Jetty Project. Since project revenue is generated from coal hauling and loading services, hauling volume is considered one of the most significant drivers of project cash flow and overall investment performance.

Table 5. Sensitivity Analysis on Coal Volume Variation

Variable Parameter	**Unit**	**Pessimistic (-10%)**	**Baseline (-)**	**Optimistic (+10%)**
Coal Volume	Mt	433,440,000	481,600,000	529,760,000
Net Present Value (NPV)	$	986,450,144	1,131,060,588	1,271,793,713
Internal Rate of Return (IRR)	%	46.32%	50.85%	55.17%
Payback Period (PP)	y	2.33	2.14	2.00
Return on Investment (ROI)	%	349.34%	392.53%	434.56%
Benefit Cost Ratio (BCR)	-	2.90	3.18	3.45

The table above presents the results of the sensitivity analysis under three scenarios: a pessimistic scenario (-10% volume), a base-case scenario, and an optimistic scenario (+10% volume). The results indicate that the project remains financially viable accross all tested scenarios.

Under the pessimistic scenario, where coal transportation volume decreases by 10% from 481.60 million MT to 433.44 million MT, the project still generates a positive Net Present

Value (NPV) of USD 986.45 million. The Internal Rate of Return (IRR) remains at 46.32%, significantly exceeding the Company's assumed discount rate of 10%. Furthermore, the project maintains a Return on Investment (ROI) of 349.34%, a Benefit Cost Ratio (BCR) of 2.90, and a Payback Period of 2.33 years. These results indicate that the project remains financially attractive even under lower transportation volume conditions.

Conversely, in the optimistic scenario, where coal transport volume increases by 10% to 529.76 million MT, the project's financial performance improves significantly. The NPV increases to USD 1.27 billion, while the IRR rises to 55.17%. The ROI increases to 434.56%, the BCR improves to 3.45, and the Payback Period shortens to approximately 2.00 years. These results indicate that increasing transport volume can substantially increase project value and accelerate investment returns.

Overall, the sensitivity analysis confirms that coal hauling and loading volumes significantly impact the project's financial performance. Nevertheless, the project remains financially viable under both pessimistic and optimistic scenarios, as evidenced by a positive NPV, an IRR well above the required rate of return, a BCR greater than one, and a relatively short payback period. Therefore, the Muara Pahu Coal Hauling Road and Jetty Project can be considered resilient to moderate fluctuations in hauling volumes and capable of generating sustainable financial returns under varying operational conditions.

1. Impact of Hauling and Loading Tariff Changes

Coal hauling and loading rates are key revenue drivers for the Muara Pahu Coal Hauling Road and Jetty Project. Unlike coal mining projects, where revenue is directly influenced by the coal selling price, this project generates revenue from logistics services, specifically coal hauling and loading activities at the jetty. Therefore, changes in benchmark rates can directly impact project revenue, operational cash flow, and overall financial viability.

In this sensitivity analysis, the coal transport volume, OPEX, CAPEX, and the discount rate are held constant, while hauling and loading rates are adjusted by ±10 %. This approach isolates the impact of tariff changes on the project's financial performance. Overall, the tariff sensitivity analysis confirms that the project is highly responsive to changes in service tariff assumptions. However, even under a pessimistic tariff scenario, all feasibility indicators remain strong, indicating that the Muara Pahu project is resilient to moderate changes in hauling and loading tariffs.

2. Impact of Operating Cost Changes

Operational costs are another important variable that can impact the financial performance of the Muara Pahu Coal Hauling Road and Jetty Project. Operational costs include coal haul road maintenance, operational support costs, jetty labour costs, fuel and utilities, and other jetty operating costs. Changes in these cost components may occur due to inflation, fuel price fluctuations, increased labour costs, maintenance intensity, or changes in operational conditions.

Unlike the revenue-related variables, the optimistic scenario for operating costs assumes a 10% cost reduction, while the pessimistic scenario assumes a 10% cost increase. This reflects the fact that lower operating costs improve project performance, while higher operating costs reduce project value.

Based on a sensitivity analysis, the project remains financially viable under all tested OPEX scenarios. Under a pessimistic scenario, where operating costs increase by 10 %, the

project still generates a positive NPV of USD 1.10 billion, an IRR of 49.80 %, an ROI of 382.77 %, a BCR of 3.12, and a Payback Period of 2.19 years.

In the optimistic scenario, where operating costs decrease by 10 %, the project's financial performance improves slightly, with NPV increasing to USD 1.16 billion, IRR reaching 51.90 %, ROI increasing to 402.29 %, BCR improving to 3.24, and Payback Period shortening to 2.11 years.

Overall, the results indicate that the project is less sensitive to changes in operating costs compared to changes in coal volume and transportation rates. This is because the project's revenue generation is relatively strong compared to its operating cost base. Therefore, moderate changes in operational expenditure (OPEX) do not materially weaken the financial viability of the Muara Pahu project.

3. Impact of Discount Rate Changes

The discount rate represents one of the most important assumptions in Discounted Cash Flow (DCF) analysis because it reflects the opportunity cost of capital and the level of risk associated with the project's future cash flows. Changes in macroeconomic conditions, financing costs, investor expectations, and market conditions can affect the discount rate used to evaluate investment projects. Therefore, sensitivity analysis was conducted to assess the effect of changes in the discount rate on the financial feasibility of the Muara Pahu Coal Hauling Road and Jetty Project.

In this study, the base case analysis applies a 10% discount rate, which is considered to represent the project's required rate of return. To evaluate the project's resillience under different financing conditions, two alternative scenarios are examined, a pessimistic scenario using a 12 % discount rate and an optimistic scenario using an 8 % discount rate, while holding all operational assumptions constant.

Table 6. Sensitivity Analysis on Discount Rate

Variable Parameter	Unit	Pessimistic (12%)	Baseline (10%)	Optimistic (8%)
Coal Volume	Mt	481,600,000	481,600,000	481,600,000
Net Present Value (NPV)	$	994,836,422	1,131,060,588	1,287,485,404
Internal Rate of Return (IRR)	%	50.85%	50.85%	50.85%
Payback Period (PP)	y	2.14	2.14	2.14
Return on Investment (ROI)	%	392.53%	392.53%	392.53%
Benefit Cost Ratio (BCR)	-	2.94	3.18	3.45

Based on the results presented in Table above, the project remains financially viable under all tested discount rate scenarios. Under the pessimistic scenario, where the discount rate increases to 12%, the project continues to generate a positive Net Present Value (NPV) of USD 994.84 million and a Benefit Cost Ratio (BCR) of 2.94. These values remain well above the minimum acceptance criteria, indicating that the project retains substantial economic value even under higher cost of capital assumptions.

On the other side, in the optimistic scenario, where the discount rate decreases to 8 %, the project's NPV increases to USD 1.29 billion, and the BCR improves to 3.45. The higher present value reflects a lower opportunity cost of capital applied to future cash flows, thereby increasing the project's estimated economic attractiveness.

It is also observed that the Internal Rate of Return (IRR), Return on Investment (ROI), and Payback Period remain unchanged across all discount rate scenarios. This is because these indicators are derived directly from the project's cash flow projections and are independent of the discount rate assumptions used in the DCF valuation process. Therefore, while changes in the discount rate significantly impact valuation-based indicators such as NPV and BCR, they do not alter the project's underlying operational profitability.

Overall, the sensitivity analysis demonstrates that the Muara Pahu Coal Hauling Road and Jetty Project remains robust under various discount rate assumptions. Even when evaluated using higher required rates of return, the project continues to demonstrate positive economic value and attractive financial performance. These findings indicate that the project's viability is resilient to moderate fluctuations in the cost of capital and financing conditions.

4. Summary of Sensitivity Analysis

The sensitivity analysis conducted in this study demonstrates that the Muara Pahu Coal Hauling Road and Jetty Project remains financially viable under all tested scenarios. Variations in coal haulage volume, haulage and loading rates, operating costs, and discount rates influence the magnitude of the project's financial indicator. However, none of the scenarios resulted the project economically unviable. The positive Net Present Value (NPV), Internal Rate of Return (IRR) exceeding the required rate of return, Benefit Cost Ratio (BCR) greater than one, high Return on Investment (ROI), and relatively short Payback Periods were consistently observed across all scenarios.

Similarly, changes in coal transport volume also have a substantial impact on project performance. A 10% decrease in projected volume reduces the NPV to USD 986.45 million and lowers the IRR to 46.32%. Given that project revenue is directly derived from transportation volume, fluctuations in transported volume significantly impact future cash flows and investment returns.

Conversely, this project appears relatively less sensitive to changes in operating costs and discount rates. Although increased OPEX and a higher discount rate reduce the project's value, the resulting NPV, IRR, ROI, Payback Period, and BCR remain within financially acceptable levels. This indicates that the project's profitability is supported by a strong revenue base and a moderate operating cost structure.

Overall, the sensitivity analysis confirms the robustness of the Muara Pahu Coal Hauling Road and Jetty Project. Even under pessimistic assumptions, all feasibility indicators continue to meet the investment acceptance criteria established in this study. Therefore, the project can be considered resilient to moderate fluctuations in key operational and financial variables, and capable of generating sustainable economic value under varying business conditions.

Closing

In closing this chapter, the combined results of the Capital Budgeting, Cost Benefit Analysis, and Sensitivity Analysis consistently demonstrate that the Muara Pahu Coal Hauling Road and Jetty Project is financially viable, economically beneficial, and strategically valuable for Bangun Group. The project not only generates attractive financial returns under baseline

scenario assumptions, but also demonstrates resilience under various adverse scenarios. Therefore, the project provides a strong investment proposition to support the Company's long term operational reliability, production growth, and business sustainability.

CONCLUSION

This study concluded that the Muara Pahu Coal Hauling Road (CHR) and Jetty Project was financially feasible, strategically beneficial, and operationally resilient for Bangun Group. The project generated a positive Net Present Value (NPV), an Internal Rate of Return (IRR) exceeding the Weighted Average Cost of Capital (WACC), an attractive Return on Investment (ROI), and a relatively short Payback Period, indicating strong economic viability. Sensitivity analysis further demonstrated that the project remained financially robust under various changes in transportation volumes, tariffs, operating costs, and discount rates. Beyond financial returns, the project strengthened logistics reliability by reducing dependence on river transportation routes vulnerable to seasonal disruptions, improving operational efficiency, supporting future production growth, and creating opportunities for additional revenue through third-party infrastructure utilization. These findings indicated that the project represented not merely an infrastructure investment but also a strategic initiative that enhanced operational continuity, competitive advantage, and long-term sustainability. To maximize its value, Bangun Group should optimize infrastructure utilization, conduct periodic financial and operational evaluations, and strengthen strategic risk management practices to adapt to changing market, regulatory, and industry conditions.

REFERENCES

Abubakar, H. M., Bala, H. M., & Mohammed, A. (2025). *Impact of Infrastructural Deficiencies on the Organizational Performance of Manufacturing Firms in Kano Metropolis*.

Albertzeth, G., Pujawan, I. N., Hilletofth, P., & Tjahjono, B. (2020). Mitigating transportation disruptions in a supply chain: a cost-effective strategy. *International Journal of Logistics Research and Applications*, *23*(2), 139–158.

Ardiansyah, M. (2024). Integrating corporate social responsibility into business strategy: creating sustainable value. *Involvement International Journal of Business*, *1*(1), 29–42.

Bayoumi, E. O., Elgazzar, S., Abdel Bary, A., & Ricci, S. (2021). The role of road transport infrastructure investments on logistics performance. A research Agenda. *International Business Logistics Journal*, *1*(2), 16–27.

Epstein, M. J. (2018). *Making sustainability work: Best practices in managing and measuring corporate social, environmental and economic impacts*. Routledge.

Igini, M. (2024, June 26). *Fossil fuel comprised 82% of global energy mix in 2023*. Earth.Org. https://earth.org/fossil-fuel-accounted-for-82-of-global-energy-mix-in-2023-amid-record-consumption-report/

International Energy Agency. (2025). *Global energy review 2025*. IEA. https://www.iea.org/reports/global-energy-review-2025

Ivanov, D., Das, A., & Choi, T.-M. (2018). New flexibility drivers for manufacturing, supply chain and service operations. In *International Journal of Production Research* (Vol. 56, Issue 10, pp. 3359–3368). Taylor & Francis.

Kanike, U. K. (2023). Factors disrupting supply chain management in manufacturing industries. *Journal of Supply Chain Management Science*, *4*(1–2), 1–24.

Lee, H. L., & Shen, Z.-J. M. (2020). Supply chain and logistics innovations with the Belt and

Road Initiative. *Journal of Management Science and Engineering*, *5*(2), 77–86.
Markovic, P., Stevanovic, D., Kolonja, B., Slavkovic, D., & Krzanovic, D. (2025). A hybrid model for risk-based strategic planning in open-pit mining: Integrating deterministic, stochastic, and ISO 31000 approaches. *Applied Sciences, 15*(5), 2500. https://doi.org/10.3390/app15052500
Notteboom, T., & Neyens, K. (2017). The future of port logistics: meeting the challenges of supply chain integration. *ING Bank: Bruselas, Belgium*.
Nuswanto, V. B., Gustomo, A., Aprianingsih, A., & Febriansyah, H. (2024). The Green Human Resource Management Framework: Exploring the Implementation Phases for Sustainable Coal Mining Operations. *Grey Journal (TGJ)*, *20*(2).
Onah, T. F., Asuquo, G. S., Sunday, V. E., & Nwakile, T. C. (2026). Maritime logistics shipping performance port productivity and inland waterways infrastructure as determinants of sustainable agricultural supply chain efficiency in Nigeria. *Discover Sustainability*, *7*(1), 698.
Paul, S. K., Asian, S., Goh, M., & Torabi, S. A. (2019). Managing sudden transportation disruptions in supply chains under delivery delay and quantity loss. *Annals of Operations Research*, *273*(1), 783–814.
Rosada, F. (2025). Reforming Environmental Governance in Response to Indonesia's Nickel Industrial Policy: A Critical Assessment of Sustainability Challenges. *Global: Jurnal Politik Internasional*, *27*(1), 75–102.
Ross, S. A., Westerfield, R. W., & Jaffe, J. (2019). *Corporate finance* (12th ed.). McGraw-Hill Education.
Schaltegger, S., & Wagner, M. (2017). *Managing the business case for sustainability: The integration of social, environmental and economic performance*. Routledge.
Sinha, K. C., Labi, S., & Agbelie, B. R. D. K. (2017). Transportation infrastructure asset management in the new millennium: continuing issues, and emerging challenges and opportunities. *Transportmetrica A: Transport Science*, *13*(7), 591–606.
Yao, X., Almatooq, N., Askin, R. G., & Gruber, G. (2022). Capacity planning and production scheduling integration: improving operational efficiency via detailed modelling. *International Journal of Production Research*, *60*(24), 7239–7261.