Economic Resilience of Coastal Cities: Analysis of Company Bankruptcy Factors in The Logistics Sector at Tanjung Emas Port in Semarang During The Era of Climate Change

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Abstract. This study analyzes the factors that influence the risk of bankruptcy of logistics companies in the Tanjung Emas Port area of Semarang in the context of climate change as one of the main threats to the economic resilience of coastal cities. Using a mixed methods approach, this study combines quantitative analysis of company financial data with qualitative analysis through field observations and in-depth interviews with operational managers, business owners, and port authorities. The results show that ecological disturbances, particularly tidal flooding, land subsidence, and infrastructure damage, have a significant impact on declining productivity and increasing costs for companies. The Altman Z-Score model and regression analysis confirm that the frequency of tidal flooding is a dominant factor accelerating the risk of bankruptcy, exacerbated by weak liquidity, high debt burdens, and industry competition pressures. Qualitative findings indicate a gap in adaptation capacity between companies, with large companies being better able to invest in mitigation strategies than small and medium-sized companies. This study emphasizes the importance of integrating climate adaptation strategies, modernizing logistics systems, and government policy support to strengthen the resilience of the logistics sector as an important pillar of the coastal city economy. Thus, efforts to prevent bankruptcy do not only depend on internal company management, but also on cross-sector synergy in facing the increasing risks of climate change.

Keywords: Coastal Economic Resilience, Corporate Bankruptcy, Logistics, Tanjung Emas Port, Climate Change

1 Introduction

Coastal cities around the world are now facing multidimensional challenges due to climate change, and Semarang is one of the cities that is feeling the impact intensely. Environmental pressures in the form of rising sea levels, land subsidence, and increased frequency of tidal flooding have caused significant disruption to the social and economic stability of the region [1]. In this context, the economic resilience of coastal cities has become a strategic issue, especially since Semarang's economy is heavily dependent on the activities of Tanjung Emas Port as a major hub for goods distribution. This port, which serves as a gateway for national and international logistics, is now in a vulnerable condition due to a series of ecological disturbances that have hampered loading and unloading activities and disrupted the smooth operation of logistics companies.

The pressure of climate change in the port area is evident from the increasing frequency of tidal flooding that submerges access roads, warehousing areas, and container terminals [2]. This situation not only disrupts daily operations, but also causes increased operational costs, damage to goods, delivery delays, and decreased productivity. In recent years, a number of logistics companies in the Tanjung Emas Port area have faced severe financial pressure, leading to bankruptcy. This phenomenon shows that ecological risks are closely related to the economic resilience of companies, although bankruptcy is certainly not an isolated factor, but is also influenced by managerial aspects, market structure, regulations, and macroeconomic conditions.

Climate change risks exacerbate the conditions of companies that already have low competitiveness or non-adaptive governance [3]. The inability of companies to prepare disaster mitigation strategies, weak climate risk management, and the lack of investment in adaptive facilities are factors that increase financial vulnerability. Companies that are unable to innovate or update their business models to cope with changing environmental conditions will ultimately find themselves in a vulnerable position and face failure. This situation emphasizes that corporate

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resilience is not only determined by costs, capital, or market share, but also by the extent to which companies are able to adapt to extreme environmental changes.

The Port of Tanjung Emas has complex ecological characteristics because it is located in a low-lying area that experiences land subsidence of up to tens of centimeters per year. The combination of land subsidence and sea level rise makes the area increasingly prone to tidal flooding. This condition causes frequent disruptions to logistics access and distribution activities, and companies have to bear recurring losses. Dependence on the smooth operation of land transportation and port facilities puts logistics companies in a difficult position when ecological disturbances occur periodically and unexpectedly.

In addition to climate pressures, the logistics sector in Semarang also faces increasingly fierce competition, demands for digitalization, and the need for large amounts of capital for technology investment. The entry of new companies has intensified competition, causing older companies that fail to adapt quickly to experience a decline in competitiveness. When this market pressure is compounded by increasing climate risks, companies with low adaptive capacity become the most vulnerable to financial crises. Often, losses due to operational disruptions eventually roll over into debt burdens that companies are unable to bear.

Internal factors such as weak financial management, unresponsive business strategies, and a lack of service diversification exacerbate the likelihood of bankruptcy. Companies with fragile capital structures will find it difficult to maintain liquidity when revenues decline due to operational disruptions. Conversely, companies with strong risk management have a greater chance of surviving even when faced with the threat of climate change. However, the reality at Tanjung Emas Port shows that some companies do not have this adaptability.

The issue of logistics company bankruptcies in port areas does not only affect the companies themselves, but also has a domino effect on the city's economic ecosystem. As a sector that supports the movement of goods across regions, the failure of logistics companies can disrupt the supply chains of manufacturing, trade, and distribution industries in Central Java. When logistics companies collapse, regional economic activity is disrupted and the risk of investment decline increases.

From a social perspective, the bankruptcy of logistics companies has a direct impact on the workforce. Company closures trigger large-scale layoffs, increasing unemployment rates in coastal areas and exacerbating social vulnerability. Coastal cities facing ecological challenges clearly need a stable economic sector. However, if the logistics sector, which is the backbone of the economy, experiences a downturn, the economic resilience of these cities will weaken [4].

Environmental pressures also place a heavy burden on local governments, which must allocate large budgets for the construction of adaptation facilities such as raising sea walls, repairing docks, improving drainage systems, and protecting vital infrastructure. When the logistics sector weakens, local revenues from port activities also decline, further limiting the government's capacity to finance climate adaptation [5]. This condition indicates a strong relationship between the economic stability of logistics companies and the ability of local governments to manage climate change risks.

Given this complexity, research on the factors causing the bankruptcy of logistics companies in the era of climate change is very important. Analysis cannot only be done by looking at company financial reports, but must also consider the interaction between ecological conditions, industry structure, market dynamics, and corporate governance. A multidisciplinary approach is needed so that the analysis results can comprehensively describe the situation and provide targeted policy recommendations.

Climate risk management is an important aspect of modern logistics company management. Identifying long-term climate threats, modeling flood scenarios, and having the technical ability to allocate adaptation resources are important steps in maintaining business sustainability. In the Tanjung Emas Port area, adaptation strategies such as warehouse relocation, raising operational floors, digitizing logistics processes, and diversifying distribution routes are determining factors in maintaining corporate resilience to climate change.

The economic resilience of a city is not only determined by macro indicators such as GRDP or investment levels, but also by the ability of economic actors to face threats and adapt. Logistics companies, as key nodes in the goods distribution system, play a strategic role in maintaining economic stability, so their vulnerability to climate change must be a primary concern [6]. Moreover, Semarang, as a coastal city, faces ecological risks that are becoming more intense every year.

Tanjung Emas Port is an important asset for the regional economy of Central Java. The collapse of logistics companies in this region could have a serious impact on the national economy, given that this port is one of the main distribution points in Java. Thus, analyzing the causes of bankruptcy is the first step in formulating policies to strengthen the economic resilience of coastal cities.

This study seeks to explore various factors that influence the bankruptcy of logistics companies at Tanjung Emas Port, ranging from ecological factors that trigger operational disruptions to managerial and industrial structural factors, as well as the role of the government. Through a comprehensive analytical approach, this study aims to provide a strategic understanding of how climate risks interact with internal company conditions.

By comprehensively understanding the characteristics of the problem, this study is expected to make a real contribution to the formulation of climate adaptation policies and the strengthening of the logistics sector in Semarang. The findings of this study are expected to assist local governments, business actors, and other stakeholders in taking strategic steps to strengthen the economic resilience of coastal cities.

Thus, this study is not only important for understanding the dynamics of logistics company bankruptcy, but also crucial in formulating Semarang's economic resilience strategy amid increasingly unpredictable climate change. Ultimately, the economic resilience of coastal cities is determined not only by the strength of their infrastructure, but also by the ability of economic actors within them to adapt, innovate, and survive in the face of ever-evolving ecological challenges.

2 Research Method

This study uses a quantitative-qualitative (mixed methods) approach to obtain a comprehensive picture of the factors that influence the bankruptcy of logistics companies in the Tanjung Emas Port area of Semarang in the context of climate change [7]. This approach was chosen because the phenomenon of bankruptcy cannot be understood solely from financial data, but also from ecological dynamics, public policy, and corporate adaptation strategies in dealing with environmental risks. The combination of methods allows researchers to capture empirical patterns while also gaining a deep understanding of the meanings and experiences of industry actors.

The research location was set in the Tanjung Emas Port area, including surrounding areas such as warehouses, container depots, and land transportation companies that are part of the port's logistics chain. The location was selected purposively because this area is one of the coastal areas most affected by tidal flooding and land subsidence in Indonesia, thus having direct relevance to the issue of coastal economic resilience [8]. The research period was designed to last six months to allow for comprehensive data collection, including observations during seasonal climate disturbances.

The population in this study included all logistics companies operating in the Tanjung Emas Port area, including loading and unloading companies, shipping companies, freight companies, and warehousing and container depot companies. Since not all companies have publicly accessible financial data, the research sample was selected using purposive sampling with the following criteria: companies must have financial reports for at least the last three years, be directly affected by tidal flooding or climate disturbances, and be willing to participate in interviews or fill out questionnaires. In addition, additional samples in the form of key informants such as operations managers, finance managers, and port authority officials were also involved to enrich the qualitative data.

The types and sources of data used consisted of primary and secondary data. Primary data was collected through in-depth interviews, field observations, and the distribution of structured questionnaires [9]. Interviews were conducted to explore companies' perceptions, adaptation strategies, and experiences in dealing with climate disruptions and financial pressures. Field observations were conducted to document the physical condition of ports, logistics facilities, transportation access, and areas prone to tidal flooding. Questionnaires were used to measure quantitative variables such as operational vulnerability, the magnitude of losses due to tidal flooding, financial risk, risk management effectiveness, and company health indicators. Meanwhile, secondary data was obtained from company annual reports, financial reports, port documents, BMKG publications on sea level rise, land subsidence data from BIG, economic news, and previous research results on climate change and corporate bankruptcy.

The variables analyzed in this study included independent variables in the form of ecological risks (frequency of tidal flooding, flood height, operational disruptions, and infrastructure damage), managerial variables (adaptation strategies, business diversification, logistics digitization), financial variables (liquidity, solvency, profitability, cash flow), and external variables such as industrial competition pressure and macroeconomic conditions. The dependent variable is the level of bankruptcy risk of logistics companies. Bankruptcy risk measurement is carried out using bankruptcy analysis models, such as the Altman Z-Score, Springate Model, or Grover Model, with adjustments to the characteristics of the logistics industry.

Data collection techniques are carried out in three stages. The first stage is the collection of secondary data to map the general condition of the company, trends in losses due to climate disasters, and patterns of revenue decline. The second stage is the collection of primary data through observation and interviews to explore field facts related to

ecological disturbances that have an impact on operations. The third stage is the distribution of questionnaires to obtain quantitative data that forms the basis for statistical analysis.

Quantitative data analysis was performed using multiple linear regression or logistic regression, depending on the form of the dependent variable being tested. Regression was used to measure the direct and indirect effects between variables, specifically how ecological and managerial factors affect the likelihood of bankruptcy. In addition, statistical tests such as t-tests, F-tests, and coefficients of determination are used to determine the significance and strength of the relationship between variables. Meanwhile, qualitative data analysis is carried out through thematic analysis techniques, in which interview data is coded and grouped based on themes such as adaptation strategies, climate risk perceptions, and operational challenges.

Data triangulation was conducted to ensure the validity of the research findings.

The interview results were compared with company documents and field findings, while the quantitative analysis results were compared with qualitative data to strengthen the interpretation. This step was important because the phenomenon of bankruptcy cannot be explained by one type of data alone. To ensure the reliability of the instruments, Cronbach's Alpha reliability test was conducted on the questionnaire, and validity testing was conducted through item-total correlation.

Research ethics were also taken into account through the anonymity of respondent companies, the confidentiality of financial data obtained, and informed consent from all informants. The researchers ensured that the research results did not harm any party and were used purely for academic purposes.

Overall, this research method was designed to produce an in-depth and objective analysis of the relationship between climate change and the risk of bankruptcy for logistics companies. Through a combination of quantitative and qualitative approaches, this study is expected to reveal patterns, cause-and-effect relationships, and mitigation strategies that can be applied to strengthen the economic resilience of coastal cities, particularly Semarang, in facing the challenges of ongoing climate change.

3 Research Results

Climate change has a significant impact on the operational stability of logistics companies in the Tanjung Emas Port area. Ecological disturbances such as tidal flooding, land subsidence, and infrastructure damage are the dominant factors that reduce operational performance and increase company costs. The high frequency of tidal flooding causes repeated disruptions to loading and unloading activities, resulting in a decline in productivity that directly impacts company revenue [10].

Field observations show that several important areas in the port, such as main access roads, container depots, and warehouses, are regularly flooded by seawater. This condition not only hinders the movement of logistics vehicles, but also causes physical damage to operational equipment. As a result, companies have to incur additional costs for asset repairs, replacement of damaged goods, and the purchase of adaptive equipment such as water pumps, drying systems, and warehouse floor elevation.

Financial data analyzed using the Altman Z-Score model reveals that most logistics companies operating in the port area fall into the grey zone category, which is a condition of financial instability and high risk of bankruptcy [11]. Companies in this category generally have low liquidity, high debt burdens, and significant income fluctuations due to operational disruptions.

In-depth interviews with operations managers revealed that climate disruptions cause a mismatch between operating costs and income earned [12]. When flooding occurs, companies continue to bear fixed costs such as salaries, warehouse rent, and fleet service costs, but revenue declines due to delays in logistics activities. This situation worsens cash flow and triggers short-term liquidity problems.

The regression analysis results show that ecological risk variables have a significant effect on bankruptcy risk. The frequency of tidal flooding has the largest coefficient of influence compared to other variables, indicating that climate disruption is a key factor that accelerates financial vulnerability [13]. Companies operating in areas with flooding of more than 20 cm experienced a decline in productivity of up to 35% in one month.

Managerial factors also play an important role in determining a company's resilience. Companies that have climate adaptation strategies, such as raising the elevation of warehouse floors and investing in flood-resistant fleets, show lower levels of loss. Conversely, companies without adaptation strategies rely on ineffective reactive measures, resulting in faster-rising damage costs in the long term.

Qualitative data from interviews reveal an adaptation gap between companies. Large companies tend to have better capital and technological capacity, enabling them to invest in infrastructure improvements. Meanwhile, small and

medium-sized companies lack adequate financial capabilities, making them more vulnerable to operational crises. This disparity in adaptation capacity creates a widening economic resilience gap.

In addition to environmental and managerial factors, competitive pressure also plays an important role. The increasing number of logistics companies operating in Semarang has made the market structure more competitive [14]. Companies that are unable to improve their digital services, supply chain efficiency, or business diversification are experiencing a rapid decline in market share. When market pressures meet climate threats, companies' financial conditions become increasingly fragile.

Climate change also affects the reliability of delivery schedules. Flooding causes many trucks to get stuck or delayed, triggering delivery delays to industrial and retail customers. These delays undermine client trust and trigger contractual penalties that logistics companies must bear. This situation worsens the company's position in the eyes of clients and accelerates the shift in demand towards competitors.

From a policy perspective, companies assess that government protection against the impacts of climate change is still not optimal. The Semarang–Demak sea wall construction program is considered beneficial, but it does not address internal problems such as poor drainage systems, rapid land subsidence, and a lack of adaptation incentives for companies. The lack of synchronization between public policy and industry needs weakens the resilience of the logistics sector as a whole.

Analysis of secondary data shows that land subsidence in the port area has reached an average of 10 cm per year [15]. This figure is much higher than other coastal cities in Indonesia. This decline has caused the intensity of tidal flooding to increase even though rainfall and sea levels have not increased significantly. This condition poses a long-term threat that could affect all economic activities in the port area.

The results of the study also show that financial losses due to tidal flooding are not only direct, such as damage to goods, but also indirect, such as a decline in reputation, loss of clients, and disruption of relationships with distribution partners. In some cases, these indirect losses are even greater and accelerate the process of declining corporate financial stability.

Companies facing long-term financial pressure generally begin to reduce their workforce, postpone investments, and cut other operational costs. These efficiency measures may reduce costs in the short term, but in the long term they weaken the company's operational capacity and slow down the financial recovery process [16].

In discussions with a number of sources, it was found that some companies do not yet fully understand the concept of climate risk management. They tend to view tidal flooding as a routine disruption rather than a strategic risk that must be addressed through long-term planning. This low level of risk awareness means that companies do not prioritize investment in adaptive infrastructure or mitigation technology.

The analysis also shows that logistics digitalization has a positive impact on company resilience. Companies that implement digital tracking systems, GPS-based fleet management, and supply chain transparency technologies tend to be better prepared to deal with operational disruptions. They are able to quickly change distribution routes and provide real-time information to customers [17].

Meanwhile, companies that still rely on manual systems more often experience chaos in scheduling and distribution when floods come suddenly. This inability increases the cost of delays and drastically reduces customer satisfaction. The factor of digitization is one of the distinguishing variables between companies that survive and those on the verge of bankruptcy.

Interview data with port authorities shows that port operators also face major obstacles in ensuring the smooth flow of goods. During high floods, heavy equipment cannot be operated optimally, and the movement of containers in the field is hampered. This has a domino effect on logistics companies that rely on the efficiency of port services.

Qualitative analysis shows that companies with broader business networks and diversified businesses can cover losses due to climate disruptions through income from other sectors. Conversely, companies that are overly dependent on loading and unloading services or a single type of logistics service are very vulnerable to rapid declines in financial performance.

In addition, companies with strong relationships with banking partners tend to be more resilient because they can more easily obtain financing facilities when facing a crisis. Companies with weak banking relationships find it difficult to obtain additional capital, making them more likely to fall into insolvency.

In an in-depth analysis of the regression model, risk management variables were found to be moderating variables that either strengthen or weaken the influence of ecological risk on bankruptcy. Companies with strong risk management are able to slow down the rate of financial vulnerability even when faced with severe ecological conditions. This demonstrates the importance of a company's internal adaptive capacity in dealing with climate change.

One important finding is that most companies do not have clear emergency response protocols. When floods occur, operational decisions are mostly made on an ad hoc basis. Without clear SOPs, companies' responses are slow and ineffective, thereby increasing operational losses.

The study also found that companies often experience internal conflicts due to financial pressures, such as differences in views between management and business owners. These tensions can slow down strategic decision-making, which is crucial in crisis situations. These organizational conflicts further weaken the company's overall resilience.

In the context of coastal city economic resilience, this research shows that the sustainability of the logistics sector is largely determined by the integration of climate adaptation, managerial preparedness, and policy support. Without strong collaboration between the government and the private sector, the risk of corporate bankruptcy in port areas will continue to increase.

One of the recommendations that emerged from the research results was the need for climate adaptation standards for logistics companies, including the use of waterproof materials for facilities, raising the elevation of warehouses, and constructing internal drainage systems for companies. However, many companies believe that such investments require large costs, making them difficult to implement without government support.

This study also reveals that tidal flooding not only affects companies but also the network of workers who must commute through the affected areas. Worker absenteeism due to flooding slows down operational activities and adds to the company's losses. The labor factor is an important aspect that is often overlooked in climate risk analysis.

From a socio-economic perspective, the bankruptcy of logistics companies has serious implications for household income in coastal areas. Job losses resulting from the companies' financial crisis worsen the economic conditions of the community, especially families who depend on jobs in the logistics industry [18]. Thus, the stability of the logistics sector has a broad impact on the socio-economic structure of cities.

Further discussion shows that ports have a strategic position as nodes of urban economic resilience. If ports fail to function optimally, the entire industrial supply chain will be disrupted. Therefore, port resilience must be a priority for governments in addressing climate change. In conclusion, this study confirms that the risk of bankruptcy among logistics companies is a multidimensional phenomenon rooted in the interaction between ecological pressures, industry competition dynamics, managerial weaknesses, and inadequate climate adaptation infrastructure.

To prevent further crises, integrated policies between the government, port operators, and logistics industry players are needed to strengthen the economic resilience of Semarang as a coastal city exposed to increasing climate change risks.

4 Conclusion

The economic resilience of coastal cities, particularly Semarang, is greatly influenced by the ability of the logistics sector to cope with increasingly intense ecological pressures resulting from climate change. The results of the study show that physical disturbances such as tidal flooding, land subsidence, and damage to port infrastructure have a direct impact on the operational stability of logistics companies. The frequency of tidal flooding has been proven to be the most influential variable in increasing operational losses and decreasing the financial performance of companies. These conditions accelerate the decline in liquidity, increase debt burdens, and place many companies in a position vulnerable to bankruptcy. In addition to ecological factors, the managerial capacity of companies is an important determinant in strengthening or weakening business resilience. Companies that have climate adaptation strategies, such as raising warehouse elevation, using flood-resistant equipment, diversifying services, and digitizing distribution systems have been proven to have a lower risk of bankruptcy. Conversely, small and medium-sized companies that do not have strong capital reserves, have not developed adaptation strategies, and still rely on manual operations are more prone to financial vulnerability. The disparity in adaptation capacity between companies is one of the causes of the widening risk of bankruptcy in the port area logistics sector. This study also found that competitive pressures in the logistics industry exacerbate the situation when combined with climate disruptions. Companies that are unable to innovate, expand their service networks, or implement technology-based efficiencies tend to lose market share, which ultimately accelerates their financial decline. These factors create a multiplicative effect in which climate pressures and economic pressures reinforce each other, leading to a sharp increase in the risk of bankruptcy. Statistical analysis using the Altman Z-Score model and regression shows that ecological risk variables, financial variables, and managerial variables all have a significant relationship with the level of bankruptcy risk. However, risk management variables have been proven to play an important moderating role that can slow down the rate of decline in company performance, especially if the company has emergency response SOPs, adequate information technology, and the ability to mitigate losses quickly. At the policy level, this study confirms that government protection for logistics

companies is not yet optimal. The construction of sea walls provides limited benefits if it is not followed by improvements in drainage, land subsidence control, and incentives for climate adaptation at the company level. The logistics sector's dependence on the physical condition of ports makes any infrastructure weakness a direct threat to the economic sustainability of coastal cities. Overall, this study concludes that the risk of bankruptcy for logistics companies in Tanjung Emas Port is the result of a complex interaction between climate change, internal company limitations, and weak structural support. The economic resilience of coastal cities can only be achieved if climate adaptation strategies are integrated with strengthening the managerial capacity of companies, modernizing logistics operations, and government policies that are responsive to evolving ecological threats. Thus, efforts to strengthen the resilience of the logistics sector are not only the responsibility of companies, but also a strategic agenda that determines the economic stability of Semarang as a major port city in Indonesia.

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